Aviation Week and Space Technology

February 20, 1961

Army to Direct Its Own Aviation Procurement

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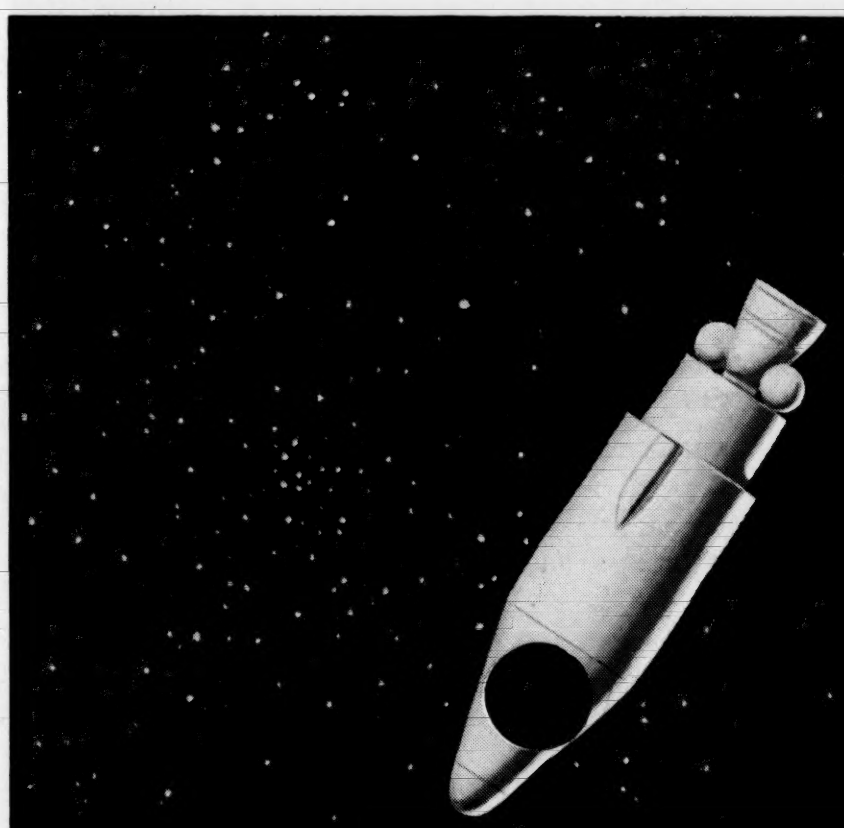

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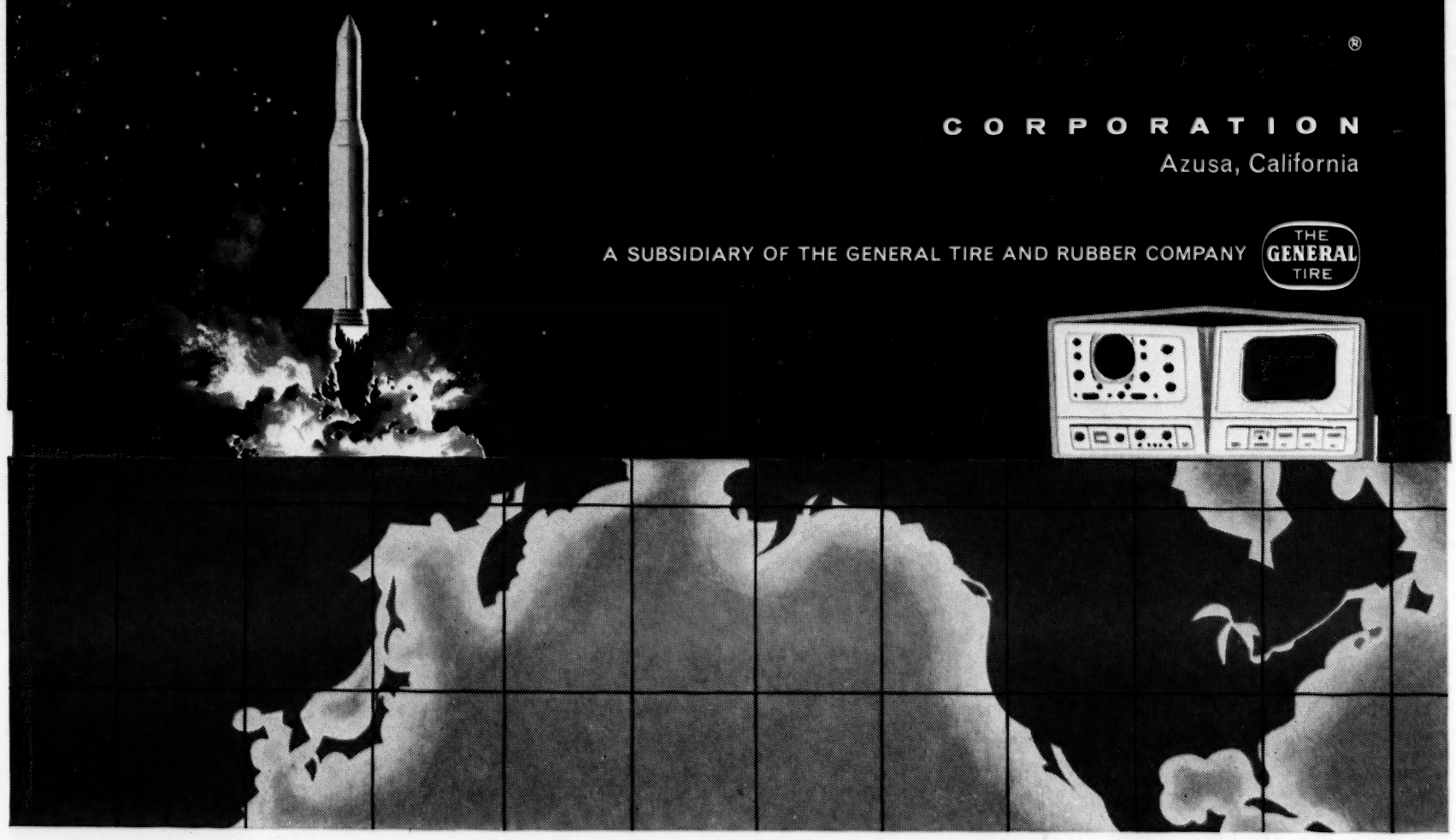

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AVIATION CALENDAR

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-16—Missile and Space Vehicle Testing Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation/Space Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 20-24—Western States Regional Convention, Society for Nondestructive Testing, Ambassador Hotel, Los Angeles.

Mar. 23-24—Third Annual Electron Beam Symposium, Alloyd Electronics Corp., Cambridge, Mass.

Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio. For information: V. W. Sikora, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

Mar. 28-29—Nucleonics in Flight Symposium, American Nuclear Society, Statler-Hilton Hotel, Dallas, Tex.

(Continued on page 6)

AVIATION WEEK and Space Technology

February 20, 1961
Vol. 74, No. 8

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

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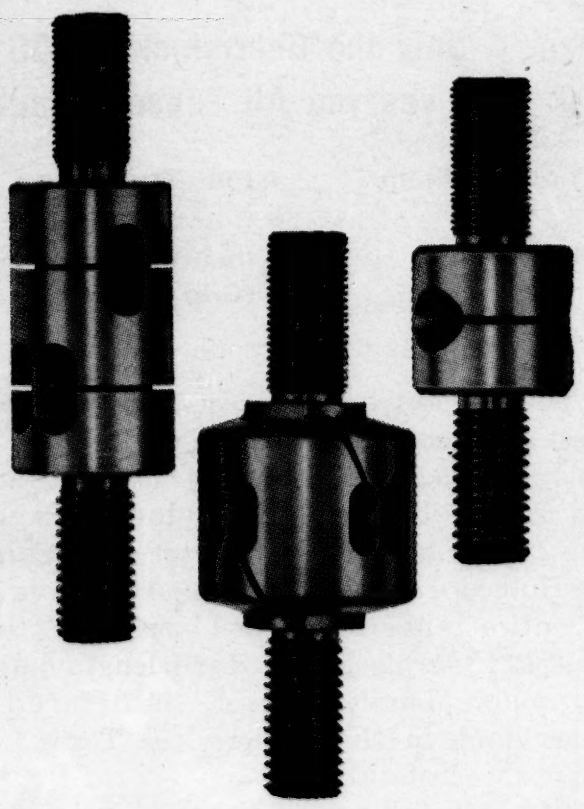

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AVIATION CALENDAR

(*Continued from page 5*)

Apr. 4-5—Aviation Technician School Administrators Conference, Purdue University, Lafayette, Ind.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 4-6—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 4-7—National Aeronautic Meeting, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Apr. 10-14—International Symposium on Aviation Research and Development, Federal Aviation Agency, Atlantic City, N. J.

Apr. 13-14—Annual Meeting, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

Apr. 13-14—Institute of the Aerospace Sciences/Army Aviation Meeting (classified), Washington, D. C.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 22-25—Annual Business Meeting and Conference, American Assn. of Airport Executives, Broadmoor Hotel, Colorado Springs, Colo.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aerospace Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aerospace Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 12-14—Mid-American Air Fair, Municipal Airport, Wichita, Kan.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 15-18—20th Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton Hotel, Akron, Ohio.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

February 20, 1961

Aviation Week and Space Technology

Vol. 74, No. 8
Member ABP and ABC

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After its towering "sail" slides beneath the sea, a U. S. Navy Polaris submarine may not surface again for many a month. But "out of sight" does not mean "out of mind." For who could forget that each FBM submarine can launch 16 Polaris missiles in as many minutes—and that each Polaris missile would destroy a major strategic target 1200 miles away? Lockheed is prime contractor and missile system manager for the Polaris. Aerojet-General Corporation makes the solid-propellant rocket motor, General Electric Company the guidance system.

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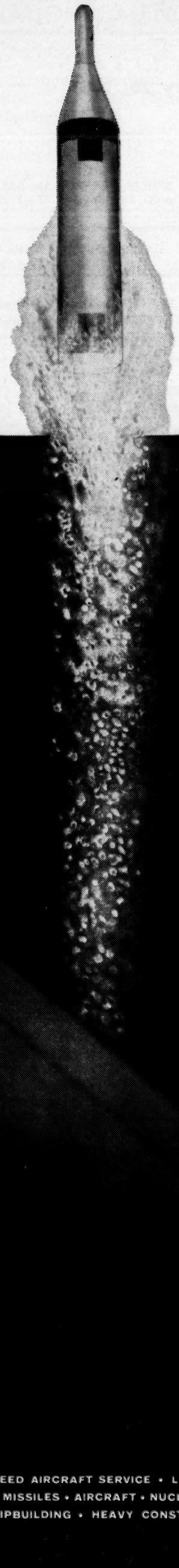

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EDITORIAL

The Stern Chase in Space

The seven-ton Sputnik VII and VIII payloads hurled into orbit and the Venus probe launched from the parking orbit of Sputnik VIII should serve notice that the Soviets do not intend to stagnate in the space race and that the stern chase we are now engaged in will not become less arduous with the passing of time. They also indicate clearly the technical folly of the "we have just enough thrust" hokum that was spread so thickly during the past three years to excuse our relatively puny payloads in space.

After several years of listening to the official apologists who tried to convince the American public that the Soviet space program was a Potemkin village—a thin facade erected solely to delude foreigners—that would eventually disintegrate and blow away, it was refreshing last week to listen to Dr. Hugh L. Dryden testify on the space race with candor and blunt technical facts before the House Science and Astronautics Committee headed by Rep. Overton Brooks (D.-La.). Dr. Dryden, now deputy administrator of NASA, has been in the thick of the international technological battle in aeronautics, and now space, for several decades, and he sees no point in not recognizing the hard fact that "we as a nation are in a scientific and technical competition with the Russians."

Nor does he see much point in evading the blunt facts that our deficiency in space booster thrust will force us to live with for the next four years. It is an inescapable fact that during these four years, NASA and the military will have nothing better than the 360,000 lb. thrust of the Atlas as a first stage booster while the Soviets are already using an 800,000 lb. thrust first stage. Not until the clustered Saturn becomes available in 1965 will the U.S. space program be able to duplicate the payloads the Soviets are already launching into orbit. Obviously, during this period we must expect to be outperformed in the major space missions where no amount of payload miniaturization can overcome the basic gap in booster thrust.

This "booster gap," as the daily newspaper pundits will probably call it when they discover it, is the key factor in the space race, and it is the reason we will have to continue to engage in a stern chase of the Soviet achievements. Dr. Dryden indicated some of the areas in which the Russians can operate during this period when our thrust deficiency will prevent us from matching their feats. These include soft lunar landings, two-man orbital space capsule flights and deep space probes to Mars.

It is encouraging to note that President Kennedy is deeply concerned by the space booster gap and presumably intends to take action to accelerate our pace in this stern chase and bring the day of interception and surpassing of the Soviets closer. However, in view of the Soviet lunar impact and orbit, the recovery of dogs and other living organisms from orbital flight in Sputnik V, the Venus probe and the gradual growth of space payloads up to seven tons, it is puzzling how his advisers convinced the President that this country leads the world in space science.

It should have been no mystery, even to the plumbers of the Wilson era in the Pentagon, that power is the key to the success of any vehicle that operates against the force of gravity. And for some strange reason, military and civilian technical planners have always been myopic in estimating future power requirements. As late as 1947, military planners were rebuffing industry designers who were proposing 10,000 lb. thrust jet engines, to be ready for the aircraft of the 1950s, on the grounds that there would never be a military requirement for so high-powered an engine.

In the missile and space field, similar attempts to sell half-million- and million-pound thrust rocket engines by industry and lower echelon military research and development experts were hooted out of the Pentagon corridors in derision by the top level planners and executives. Yet when the vehicles—either aircraft or missiles or spacecraft—actually arrived on the scene, their power requirements always proved far in excess of what the planners foresaw and authorized.

The space booster gap that we are now enduring developed through no lack of technical foresight or capability at the levels that eventually have to do the hard development work. It is with us solely because of some bad basic policy decisions made at top levels in the Pentagon three and four years ago.

It is true that through some incredible avionics industry efforts in developing miniaturized and sub-miniaturized payload components, we have been able to do many space jobs with our limited booster thrust that would otherwise have been impossible. It is also true that while their large thrust boosters gave no particular spur to the Soviets to miniaturize their space payloads, they could do more jobs per shot if they had miniaturized equipment. As their missions become more complex and demanding, they will undoubtedly develop the miniaturized equipment required. Similarly, when we get the high-powered boosters now under development, the early work in miniaturization will continue to pay off in more complex and reliable functions for any specific mission.

The entire booster program should be thoroughly examined and revised to avoid repeating the bad policy decisions of the past and to lay the foundations for sound continuing development of families of boosters, for both military and scientific exploratory requirements, that will continue to crank-in the best available input from the galloping technology of the entire propulsion spectrum. It will not be enough to develop boosters for four years hence that will equal what the Soviets are using today if we are to eliminate the booster gap and compete successfully in the space race.

It will take technical ingenuity, top priority leadership and sufficient resources to surpass the Soviet development rate and to produce boosters that are superior in performance, reliability and cost to their Soviet contemporaries.

—Robert Hotz

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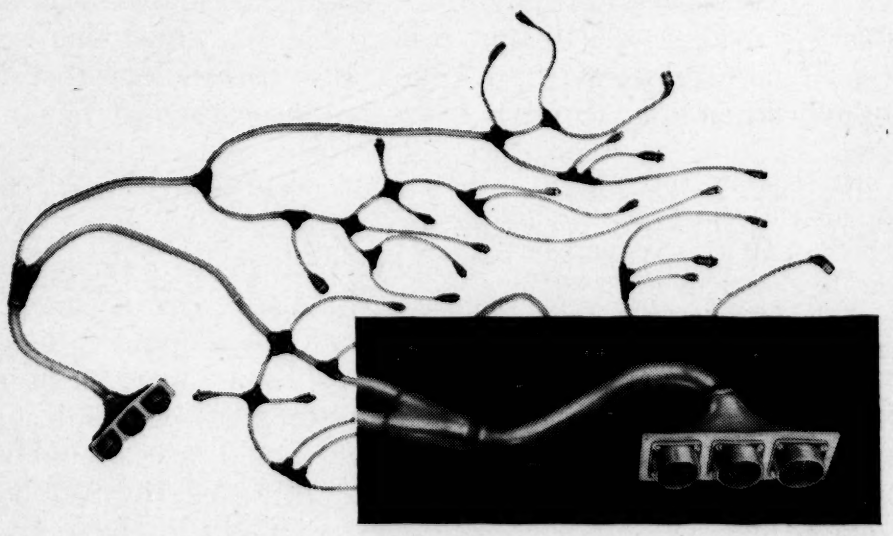
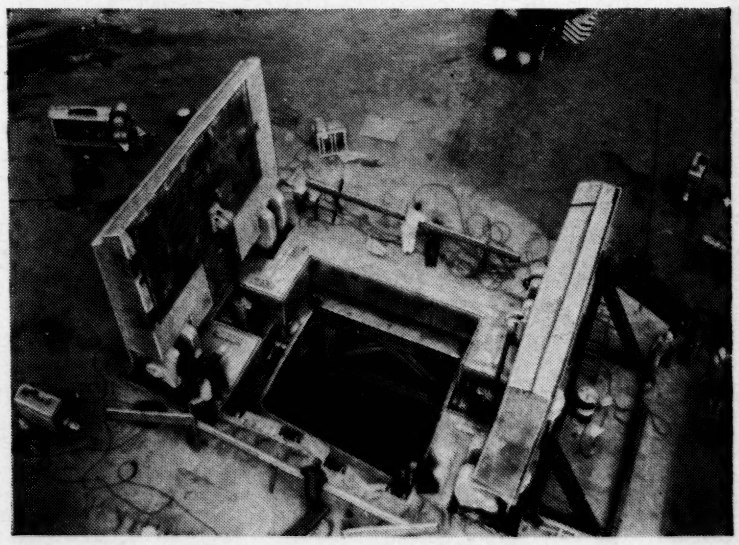


Missile wiring harness — General Electric silicone rubber was chosen by Aerojet-General Corp. for the Titan's propulsion system wiring harness. Breakouts and junctions are molded from G-E RTV (room temperature vulcanizing) silicone rubber; wiring is silicone insulated; jacketing is high-strength G-E silicone rubber. Inset shows silicone rubber inserts in connectors. RTV is used in other missiles as a shock-absorbing encapsulant and potting material for electronic assemblies.



200 tons of steel and concrete — Titan missile silo doors by American Machine & Foundry Co. use seals of G-E silicone rubber. AMF also used G-E silicone rubber door seals on the Titan's ground support entry portals and radar silos. Silicone rubber can withstand the heat of rocket blast-off or possible atomic attack while remaining stable in storage for long periods.

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GENERAL ELECTRIC

WHO'S WHERE

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Walter H. Powell, a director, International Resistance Co., Philadelphia, Pa. Mr. Powell continues as vice president-operations.

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Eric J. Isbister, vice president-engineering, Radiation, Inc., Melbourne, Fla.

Maj. Gen. Phillips W. Smith, a vice president, Siegler Corp., Los Angeles, Calif. Gen. Smith is president of Jack & Heintz, now a division of Siegler.

Northeast Airlines, Inc., has appointed the following assistant vice presidents: **John V. Auskelis**—quality control; **Frank C. Barker**—communications; **Arthur A. Brennan**—personnel; **Maurice M. DeGroff**—traffic; **J. O. Urquhart**—passenger service; **Harry F. Zimmerman**—finance.

Cmdr. James C. Quillin, Jr., head of the newly established Transit program office, Pacific Missile Range, Point Mugu, Calif. **Tom Sherritt**, named his deputy.

Roger Hilsman, director, State Department Bureau of Intelligence and Research.

Changes

Richard L. Bean, manager of Lockheed Aircraft Corp.'s New York (N. Y.) office, succeeding **Erik Nelson**, who has been appointed corporate regional director for Canada, with offices in Ottawa.

Dr. Edward Teller and **Dr. Joseph Kaplan**, of the University of California, have been named senior technical advisers of Geophysics Corporation of America, Bedford, Mass.

Elbert J. Brandt, general manager, Universal Dynamics Division of Acoustica Associates, Inc., Santa Barbara, Calif.

George R. Leonard, general sales manager, Twin Coach Co., Buffalo, N. Y.

William R. Seigle, manager-manufacturing engineering and facilities, General Electric Co.'s Light Military Electronics Department, Utica, N. Y.

(*Continued on page 122*)

INDUSTRY OBSERVER

► Elimination of the second stage of the USAF-Douglas Skybolt missile is under discussion as a means of adapting it to the North American B-70. Two-stage design for use with the Boeing B-52 is too long for the B-70 bomb bay, and USAF does not plan to carry external stores on the Mach 3 bomber. Higher speed of the B-70 might replace the velocity increment now added by the missile's second stage.

► **Aerojet-General has an unfunded study contract for preliminary investigation of Air Force's SR-199A Positive Control Bombardment System, which is under technical supervision of Aerospace Corp. (AW Dec. 5, p. 26). Chances of this weapon system being developed now look slim.**

► Rome Air Development Center has requested bids for a Csar ground antenna hardening study. Rome has invited about nine companies to submit bids by Feb. 21, presenting a variety of ideas on ensuring the survivability of a communications satellite ground installation in a nuclear attack.

► **First test flight of an Atlas-Centaur space vehicle is expected to be delayed by the mid-January explosion of a Centaur engine package on a vertical test stand at Pratt & Whitney's Florida plant (AW Feb. 6, p. 31), but no slippage is expected in the over-all development schedule for the hydrogen-fueled upper stage. Test stand will be usable again by the end of the month.**

► Study contract for a moon tracker will be awarded soon by Wright Air Development Division to one of ten bidders. Similar in concept to a star tracker, the moon tracker is to sense emissions from the partially reflective surface of the moon and supply navigational fixes for lunar spacecraft guidance systems. Contract is not expected to exceed $100,000.

► **Navy has requested bids for construction of a complete new complex for launching Air Force space vehicles at Navy's Pt. Arguello, Calif. facility. The installation, which could accommodate Samos, Midas and Bambi satellites, would include three new launch pads, blockhouse and accessory buildings. Basic engineering for the complex has been done by Kaiser.**

► NASA is considering United Technological Corp. proposals for development of quarter-million-, half-million- and million-pound-thrust segmented solid rockets.

► **United Aircraft is studying use of hydrogen-fueled rockets in a single-stage orbiting vehicle, such as Aerospace Plane, and in manned boosters.**

► Navy is investigating the use of direct thermoelectric conversion of heat from a nuclear reactor for propulsion systems that could drive submarines faster than 50 kt. Systems burning oxygen and hydrogen or lithium hydride to create electricity and systems which would store billions of Joules of electrical energy in cryogenic metals also are under study. Weight savings involved in some of these systems could make them practical for aircraft.

► **Minuteman first stage burned 3 milliseconds less than programed duration during the missile's successful first flight, requiring the third stage engine to fire 3 sec. longer than planned. Nose cone landed within a few miles of the target point, although accuracy has not yet reached the precision of current liquid-fueled ICBMs.**

► Nord Aviation is continuing its turbojet-ramjet propulsion work, centered around its supersonic Griffon experimental interceptor, with U. S. Air Force funds. French funds alone were not sufficient to keep the Griffon flying.

► **Canadian topside sounder satellite antennas will be flight tested soon on a nose cone launched from Wallops Island, Va., by a Javelin rocket vehicle. The Canadian satellite will have two 30-ft. and two 75-ft. antennas which will be wound on a drum and unreeled in orbit.**

► Russia's Lebedev Physical Institute has produced crude maps of the thermal radiation of the moon using a new 22-meter radio telescope.

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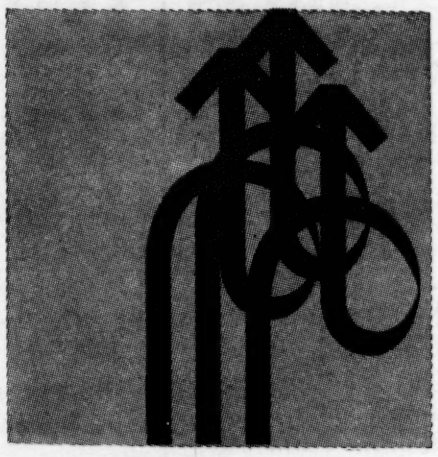

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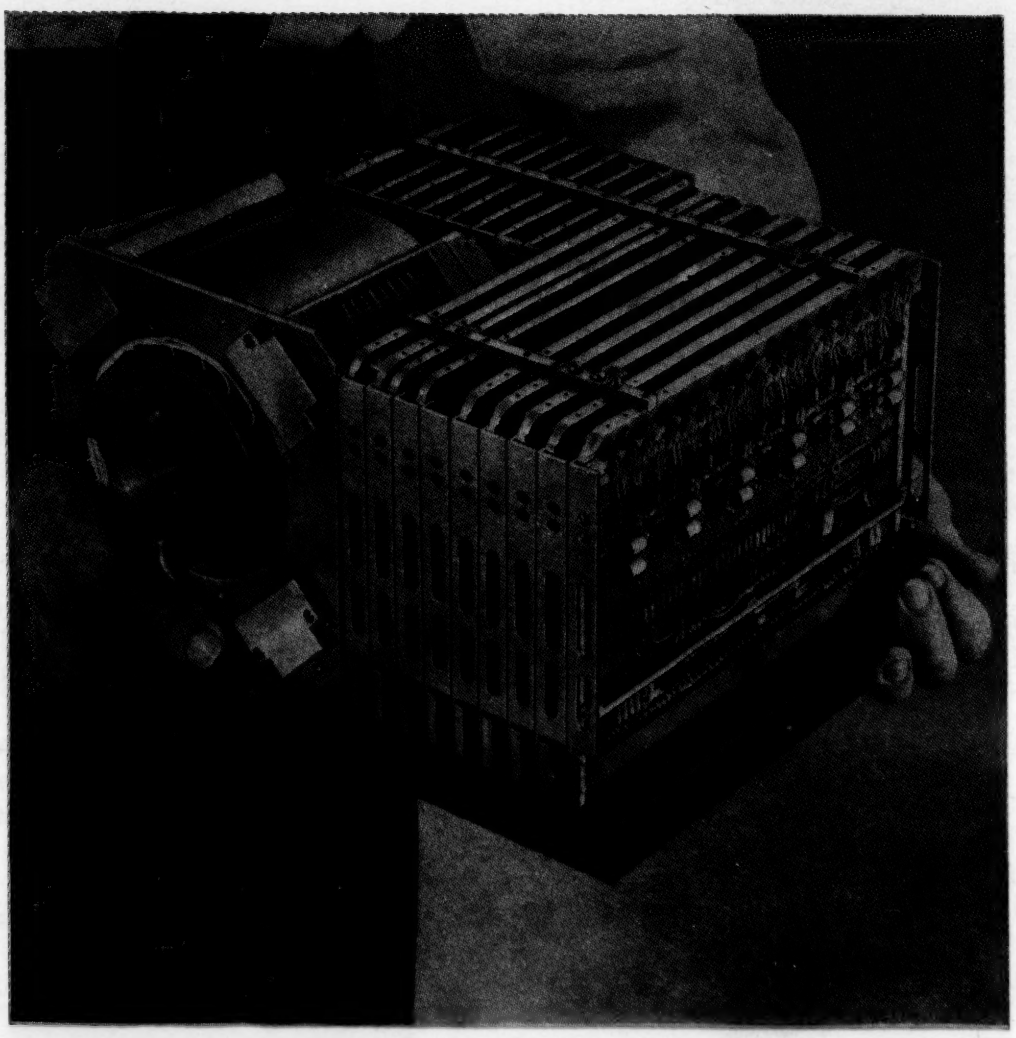


LI-04

Washington Roundup

Space Gap Awareness

Russia's orbiting of two seven-ton Sputniks eight days apart has stirred the beginnings of an awareness in Washington that the space gap is extremely serious and could become permanent unless a vast effort is made to close it. The situation is substantially what it was three years ago—Russia has a great lead in time and propulsive power—but reviews now under way should bring acceleration in both U. S. military and civilian programs.

President Kennedy, who said last week the gap "is a matter of great concern" (see p. 28), has asked civilian space chief James E. Webb to look over the entire National Aeronautics and Space Administration program and recommend changes this week.

On the military space front, there is even more activity. Before the end of this month, recommendations for a reorganized and expanded military program will be put before top Air Force officials by the special Air Research and Development Command space study groups which Trevor Gardner heads (AW Jan. 23, p. 32). These groups then will report to Defense Secretary Robert McNamara and Deputy Secretary Roswell Gilpatric.

The main Gardner group has been assisted in its intensive four-month study by a Los Alamos study group of 17 industry and government scientists, headed by Theodore Taylor, vice president of General Atomics and technical director of Project Orion, and by a special group to study organizational problems. The latter includes retired USAF Gen. Nathan Twining, former chairman of the Joint Chiefs of Staff; Charles A. Lindbergh; Frank Pace, Jr., board chairman of General Dynamics; William Baker, executive vice president of Bell Telephone Laboratories; James Kerr, president of Avco; John Floberg, former Navy under secretary and atomic energy commissioner; Malcolm McIntyre, president of Eastern Air Lines and former USAF under secretary; William C. Foster, former head of the Gaither committee and Olin-Mathieson executive vice president, and Charles Lauritsen, CalTech physics professor. The Los Alamos group also was supported by special studies made by Rand Corp., Aerospace Corp. and Rover Project personnel at Atomic Energy Commission's Los Alamos laboratory.

Urgency of the main task force's job was emphasized when Sputnik VII made three passes over one all-day session in Los Angeles and news of Sputnik VIII and the Venus probe interrupted another weekend working session.

UN Samos Inspection

Classified version of the Wiesner task force report to President Kennedy on missile and space programs suggests that the U. S. announce Samos satellite reconnaissance flights to the United Nations and invite UN inspection—but under rules defined by the U. S. The report says there is a most urgent need for a surveillance and target reconnaissance capability. But it also says a special security organization now operating to protect Samos and Midas is interfering with other military space programs.

State Department is considering filing notice 48 hr. in advance of all intercontinental ballistic missile and space launchings with the UN Committee on Outer Space as an example for Russia to follow. The suggestion came from Sen. John Stennis, who believes that a stray, unannounced missile shot could accidentally trigger World War III—particularly now that Great Britain and France, as well as Israel, Cuba and Communist China have some prospect of developing missile capabilities in the foreseeable future.

Stennis points out that since the Vanguard test launching attempt in December, 1957, the U. S. has tried 58 satellite or space probe launchings and 30 have exploded, been destroyed by the range safety officer, veered off course or otherwise failed.

Stennis' Preparedness Investigating Subcommittee has even considered investigating possible contractor responsibility for launch failures. He has named James T. Kendall, former assistant attorney general of Mississippi, as his counsel and Dr. Claude D. Baldwin, who was assistant Air Force comptroller for the past five years, as staff director.

Budget Reviews

Defense Secretary McNamara's first formal congressional appearance was scheduled for Feb. 20 before Senate Armed Services Committee. Later this week, he is due before closed hearings of the House Armed Services Committee with Gen. Lyman Lemnitzer, chairman of the Joint Chiefs of Staff.

McNamara's revised defense program is due to go to President Kennedy early next week. House Defense Appropriations Subcommittee began hearings last week on the former administration's Fiscal 1962 budget, with Lemnitzer as an early witness. Assistant service secretaries won't testify this year because many of them are too new in their jobs.

—Washington Staff

Soviets Launch Venus Probe From Orbit

Seven-ton Sputnik VIII is used as space platform; instrumented interplanetary vehicle weighs 1,418 lb.

Washington—Soviet Russia continued to capitalize on its superiority in propulsion and demonstrated advanced guidance capabilities by launching a probe to Venus from an orbiting satellite on Feb. 12 in one of the most significant engineering accomplishments to date in space.

The 1,418-lb. probe, which the Soviet Union calls an automatic interplanetary station, was boosted from its Sputnik VIII mother satellite into Venus' ecliptic plane. It is expected to pass close to Venus in mid- or late-April, and then go into an orbit around the sun. It is transmitting on ground command 922.8 mc., a frequency used to get maximum range from solar-generated power.

Soviet scientists predicted widespread use of the orbital launch technique in the future and said more sophisticated Venus probes will follow to obtain and transmit data on the planet's "flora and fauna if they exist" and on atmosphere and surface composition.

Sputnik VIII was launched in a direction opposite the earth's rotation and originally was forecast to reach its closest point to Venus in 146 days. Recalculation of the trajectory ellipse last Tuesday indicated flight time will be cut to 92-108 days.

National Aeronautics and Space Administration had planned a variation of the launch from orbit technique with its Vega launch vehicle, using stop-start capability in a parking orbit. Vega vehicle was canceled in December, 1959 (AW Dec. 19, 1959) and its missions were shifted to Atlas-Agena B.

Impact of the latest Sputniks in the United States and abroad was greater than that of most recent Soviet shots. Assessment of the Soviet space lead was studied in a hastily-called congressional inquiry (see p. 28), and comparisons of U.S. and USSR programs were made again in this country (see p. 32) and abroad.

Military Implications

Military implications of the Soviet shots were not overlooked, with European comment centering on the apparent ability of Russia to launch a warhead earthward from an orbiting space station.

Comment from Soviet-bloc countries belittled U.S. space efforts. Press reports from Warsaw, citing interviews with scientists and engineers, said "the problem of the weight of cosmic vehicles has ceased to exist for Soviet technology . . . it is an incontestable fact that the USSR is constantly outstripping the United States in production of powerful rockets that can carry their load to any point on the earth and to points in cosmic space that are beyond the reach of the Americans."

Russian explanations following launch of Sputnik VIII were more detailed than reports issued on Sputnik VII (AW Feb. 13, p. 28). Some U.S. space officials believe both Sputniks VII and VIII were essentially the same, and that Sputnik VII had the same mission as Sputnik VIII, but failed to eject its Venus probe.

Dr. Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration, expressed this opinion and said Russia may have made an attempt to launch a Venus probe last Oct. 1, when Soviet Premier Nikita Khrushchev was in this country, and failed

U. S. Opinion

Consensus of several propulsion experts in the U. S. space program is that the launch vehicles for both of latest Sputniks were identical three-stage systems with 800,000 to 1,000,000 lb. lift-off thrust. Propellant is believed to have been alcohol-oxygen or kerosene-oxygen.

Russia said the scientific objectives of the probe are to determine the following:

- **Methods of injecting** a space body into an interplanetary trajectory.
- **Performance of radio guidance** and communications over interplanetary distances.
- **Size of the solar** system, by re-

U.S. Not Tracking Soviet Venus Probe

Washington—United States is not tracking the Soviet Venus probe with its own facilities, but expects to obtain information on the probe from the Jodrell Bank station in Britain.

Minitrack and military radar networks are monitoring earth orbiting portions of the probe's mother satellite, Sputnik VIII. The only U. S. antenna capable of tracking the probe is the 85-ft. Goldstone dish, which is in the earth's shadow when Russia commands the probe to transmit.

National Aeronautics and Space Administration has a contract with Jodrell Bank, and the 250-ft. radiotelescope there has been listening on the 922.8-mc. probe frequency. Late last week, it had received no signals.

Meanwhile, the United States does not foresee a Venus probe attempt until August, 1962, when the seventh Centaur test vehicle is scheduled to carry about 1,000 lb. to the planet. Dr. Hugh L. Dryden told the House space committee of the plan (see p. 28), and he also said the second Venus shot is scheduled in 1964. Second shot, a Mariner Venus fly-by, is to be the 14th Centaur launch.

Most favorable dates for Venus launches in the next decade are Aug. 16, 1962; Mar. 28, 1964; Oct. 27, 1965; June 5, 1967, and Jan. 11, 1969. These dates, and dates for optimum Mars trajectories, were computed by the Rand Corp. for the first House space committee.

Earth-Mars optimum launch dates are Nov. 16, 1962; Dec. 23, 1964; Jan. 26, 1967, and Feb. 28, 1969.

NASA, which last week assumed responsibility for the release of satellite tracking information, has compiled this data on the two most recent Sputniks:

- **Sputnik VIII (1961 Gamma): Gamma 1 is the probe; Gamma 2 the rocket body which re-entered the earth's atmosphere soon after launch, and Gamma 3 and 4 the mother satellite which has split into two pieces. Gamma 3 last week had an 89.79-min. period, an apogee of 201.5 mi. and a perigee of 123 mi. Gamma 4 had an 89.54-min. period, 186-mi. apogee and 124-mi. perigee. A Fifth object is in the Gamma complex and has been tentatively identified as part of the payload fairing. Before the mother satellite split into Gamma 3 and 4, it had an orbital period of 86.66 min., an apogee of 196 mi. and a perigee of 125 mi.**
- **Sputnik VII (1961 Beta): The main satellite, Beta 1, is expected to re-enter the atmosphere by Feb. 22. Last-stage rocket casing, Beta 2, re-entered Feb. 12-13. Beta 3 is an object which broke loose or was ejected from the spent rocket or from the satellite, and has an estimated Mar. 1 re-entry date. The 7.1-ton satellite last week had a period of 89.66 min., an apogee of 196 mi. and a perigee of 125 mi. Beta has a 90.09-min. period, 207-mi. apogee and 148-mi. perigee.**

Space Cooperation

Washington—Soviet Premier Nikita Khrushchev last week said he welcomed President John F. Kennedy's offer to cooperate with Russia in space exploration, culture and trade and the struggle against disease.

Khrushchev's statement was made in reply to Kennedy's telegram congratulating Russia on its successful Venus space probe. "We appreciate such an approach to these problems," Khrushchev said.

The President mentioned cooperation in his State of the Union speech. He told his press conference last week after Khrushchev's remark that he hopes it will be possible to improve U. S.-Soviet relations enough this year to make cooperation in space possible.

measuring the astronomical unit—the mean distance between the earth and sun (91.9 million miles) which could be in error by as much as 30,000 mi.

Amplification of objectives came last week from these Soviet scientists:

• **Oleg Melnikov,** in charge of the Leningrad Astronomical Obesrvatory's stellar physics section: Probe will pass through the thick cloud blanket shrouding Venus and obtain first hand evidence of the planet's atmosphere.

• **Y. L. Krinov,** president of the International Meteorite Commission: Although it can be presumed that meteors are not a serious danger to space ships headed to Venus, the probe could answer another question—"Will meteorite streams comprised of many particles weighing fractions of a gram be a serious obstacle to interplanetary travel?"

Such streams are thought to occur frequently near the sun, where the probe is heading.

• **Vladimir Belousov,** chairman of the Soviet Geodesy and Geophysics Committee: A study of Venus should help answer questions about the earth. He points to the theory of planet development based on mass and distance from the sun. Although Venus' mass is about the same as the mass of the earth, it is closer to the sun, "so if Soviet scientists find some difference in structure of Venus soil, atmosphere and volcanic processes, it will be clear these differences were caused by a dose of solar energy received by the sun."

• **A. A. Severny,** director of the Crimean Astrophysics Observatory: The probe will be subjected to the effects of meteorites, high energy particles and cosmic rays.

Problems of lengthy exposure to radiation and solar flares are of great scientific and practical importance.

• **Vladimir Timakov,** vice president of the Soviet Medical Academy: Venus probe may "lift the veil from the mysteries of the origin of life."

Two days after Sputnik VIII was launched, USSR said in Moscow that the probe has a "temperature control system which ensures proper conditions for operation of equipment."

"The station carries radio equipment designed to accomplish the following tasks: measure parameters of the station's movement with relation to earth; relay to earth results of measurements carried out by scientific instrumentation on board; relay to earth information on systems operation and units on board," the Soviet news agency Tass reported recently.

During telemetry transmissions, triggered by ground command, the instrument package is powered by chemical batteries charged by solar cells. Two transmissions were commanded the first two days of operation, but some U. S. space officials feel the Soviet solar cell conversion system is not very efficient because Russia says it will receive data only every five days on the progress of its probe, and will report this data weekly.

Soviets reported trajectory measurements taken during the initial transmissions came through with substantial strength and showed all systems operated as planned, the on-board temperature was 86F, and solar cells were oriented correctly to the sun.

Soviet Academician Ari Shternfeld believes the best time to read out data on measurements of Venus' atmosphere will be between May 15 and May 29, when the distance between the earth and Venus will be smallest—about 24.9 million miles.

Soviet Discussion

Soviet public statements in the past have indicated a determination to explore Mars or Venus, but have always emphasized difficulties in communications and precise guidance.

Most recent Soviet discussion has centered around Mars.

Shternfeld wrote in the Dec. 30 issue of Economicheskaya Gazeta that Mars was 56.2 million mi. away Christmas day, the closest in two years; furthest distance will be 61.8 million mi. on Feb. 3, 1963. The gap will begin to close in 1965 and will decrease gradually until 1971, when it will reach 34.6 million mi.

Observers in Moscow could recall no such detailed discussions of flight to Venus. In last month's issue of Trud, Professor Vladimir V. Dobranravov said that "launching of an automatic station similar to the one which photographed the reverse side of the moon to the neighborhood of Mars and Venus is a matter of the not too distant future. Times of the most favorable position of earth and Mars for launching the rocket already have been calculated" (see box).

Academician L. I. Sedov, who hailed the Venus probe, also attempted to refute speculation in Italy and Germany that Sputnik VII contained humans or animals.

Sedov said the Feb. 4 satellite was purely experimental and contained "no special equipment for the study of outer space. . . . The rumors which have been spread abroad that there is a human being on the satellite do not accord with reality."

Main Objectives

He said the main objectives of the flight were to put the heavy satellite in a precise orbit, and to measure its orbital parameters.

Sedov also said the Feb. 4 payload contained "no special system for the return of the satellite to earth."

A Polish commentator said the current Soviet launch vehicle could put a "big load" into a 22,000 mi. stationary orbit. He said that "equipped with proper apparatus, which could be installed without special difficulties owing to the big weight of the launched object, the Sputnik could act as a relay station enabling a tremendous range of radio communications over ultrashort wavelengths.

F-1 Booster Fired

An uncooled "battleship" model of the NASA-Rocketdyne F-1 liquid propellant space booster has developed 1.550 million lb. of thrust in a two-second static firing at Edwards Air Force Base, Calif.

The purpose of the static test firing was to determine whether combustion instability would develop at that thrust level. The F-1 chamber has been fired more than 100 times at thrust levels between 950,000 and 1 million lb. and remained stable for about the last 40 tests. The recent firing was the first time the chamber had reached or surpassed its design maximum thrust level of 1.5 million lb. and it is the highest thrust known to be achieved by a single chamber, according to Rocketdyne. The chamber is being tested on stand 2-A at Edwards and was fired for the first time in December.

The F-1 is being developed by Rocketdyne Division of North American Aviation under a contract let by the Marshall Space Flight Center of National Aeronautics and Space Administration. The high chamber pressure of 900 psi. makes the F-1 more likely to go unstable than earlier chambers operating at lower pressures. The two-second run was made without a nozzle skirt but since instability usually occurs upstream of the nozzle throat and within 1.5 sec. of ignition, the run is considered valid.

Dryden Reports U.S. Is Not Using All Available Talent in Space Effort

By Ford Eastman

Washington—The United States is not using all of the scientific or industrial talent available in its space program, Dr. Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration, told the House Science and Astronautics Committee last week.

Dr. Dryden, responding to committee questions on whether the U.S. could expand its current space program, said there is surplus talent in both industry and universities that could be used in an expanded and accelerated space program. He also told the committee that "we as a nation are in a scientific and technical competition with the Russians" and that NASA is working as hard as it can with the resources that are available to it.

Opening Witness

He appeared as the opening witness in a major inquiry into the current status of the U.S. space program to determine whether its rate of progress is sufficient to catch and overtake the Soviet effort in this field and whether it is adequate to meet both U.S. scientific and military requirements. Dr. Dryden was scheduled to be followed by top technical officials from the secretary of defense's staff and by research and development commanders of the Army, Navy and Air Force.

Dr. Dryden also told the committee that the new NASA Administrator, James E. Webb, had been ordered to make a comprehensive review of the agency's space program and submit recommendations to President Kennedy for its revision or expansion.

He credited the current Soviet space achievements to a four-year lead over the U.S. in organizing a national space effort and to a technical superiority in developing large thrust booster rockets. He noted the Soviets organized an interplanetary group of their Academy of Sciencies in 1954, some four years before NASA was created in the United States.

The Soviets have been using their standard ICBM rocket booster as the first stage of their recent Venus probes, but have boosted their capacity for putting payloads into orbit to seven tons by using improved second stage rockets.

Dryden Warning

Dr. Dryden warned that the U.S. would not be able to match this current Soviet payload capacity until 1964, when the Saturn clustered booster is to be available, and he indicated that the Soviets would continue to employ their basic booster capacity to undertake a variety of space missions during this period that will be beyond any U.S. technical capability. These may include soft landings on the moon, orbiting and returning a two-man astronaut team, and deep space probes to the area of Mars, he said.

Initial U.S. attempt to reach the vicinity of Venus will be made in August, 1962 when two shots in the Centaur liquid hydrogen second stage rocket test program will be aimed at Venus with an 1,100 lb. payload. Dr. Dryden emphasized that these shots are primarily Centaur test shots in the early development test cycle of this vehicle. The programing toward Venus is being included in the hopes of achieving a scientific bonus and is not the main purpose of the shots.

Venus Schedule

The first all-out Venus shots would be scheduled in March, 1964, when the Centaur is to have completed its test program and should offer the capacity for a "very sophisticated job of reconnaissance" in the Venus area. Saturn is to be initially available for Venus probes in October 1965, Dr. Dryden said.

Dr. Dryden warned that there is no way to buy "a year or two of time" in booster development and that the United States will have to "sweat it out" until its big booster program produces the vehicles capable of putting large payloads into space. He pointed out that it is now impossible for U.S. boosters to put a scientific payload in the vicinity of Venus except on the days when Venus is closest to the earth, while the Soviets were able to make their shot almost a month after the optimum date of Jan. 13 had passed because of their much greater booster thrust.

Dr. Dryden also said that:

- **U.S. guidance systems** are "as good as the Russians" and that bigger and better systems are available, but the U.S. does not have the booster power to use them.
- **Scientific information** gathered through Soviet space experiments and released at scientific meetings has been sketchy and not as detailed as U.S. scientists prefer. He said he did not know if Russians are withholding details of their experiments or if they did not have the information to begin with.
- **U.S. has generally** collected more valuable scientific information, especially in the communications satellite field, and made this available to all nations, than has Russia.
- **U.S. favors talking** with Russia at every opportunity in an effort to effect cooperation in space exploration projects, but it has been difficult to find a field in which Russia would readily consent to cooperate. Russia insists that there are political problems to be solved first.
- **Use of solid fuels** for booster rockets will grow at a normal rate, but will not be used as a replacement for Saturn in heavy space missions. There are problems connected with transporting solid fuel rockets, more burning time is required to achieve a greater over-all impulse and greater reliability is required.

Booster Overtime

Washington—Some contractors developing critical Saturn booster components are working on a seven-day week, and the normal work week is on a six-day level, the National Aeronautics and Space Administration said last week.

Overtime was authorized for Saturn in November, 1958, and has continued on a 20% level, NASA said. There is no overtime involved in Centaur and F-1, the other large NASA booster projects, according to NASA.

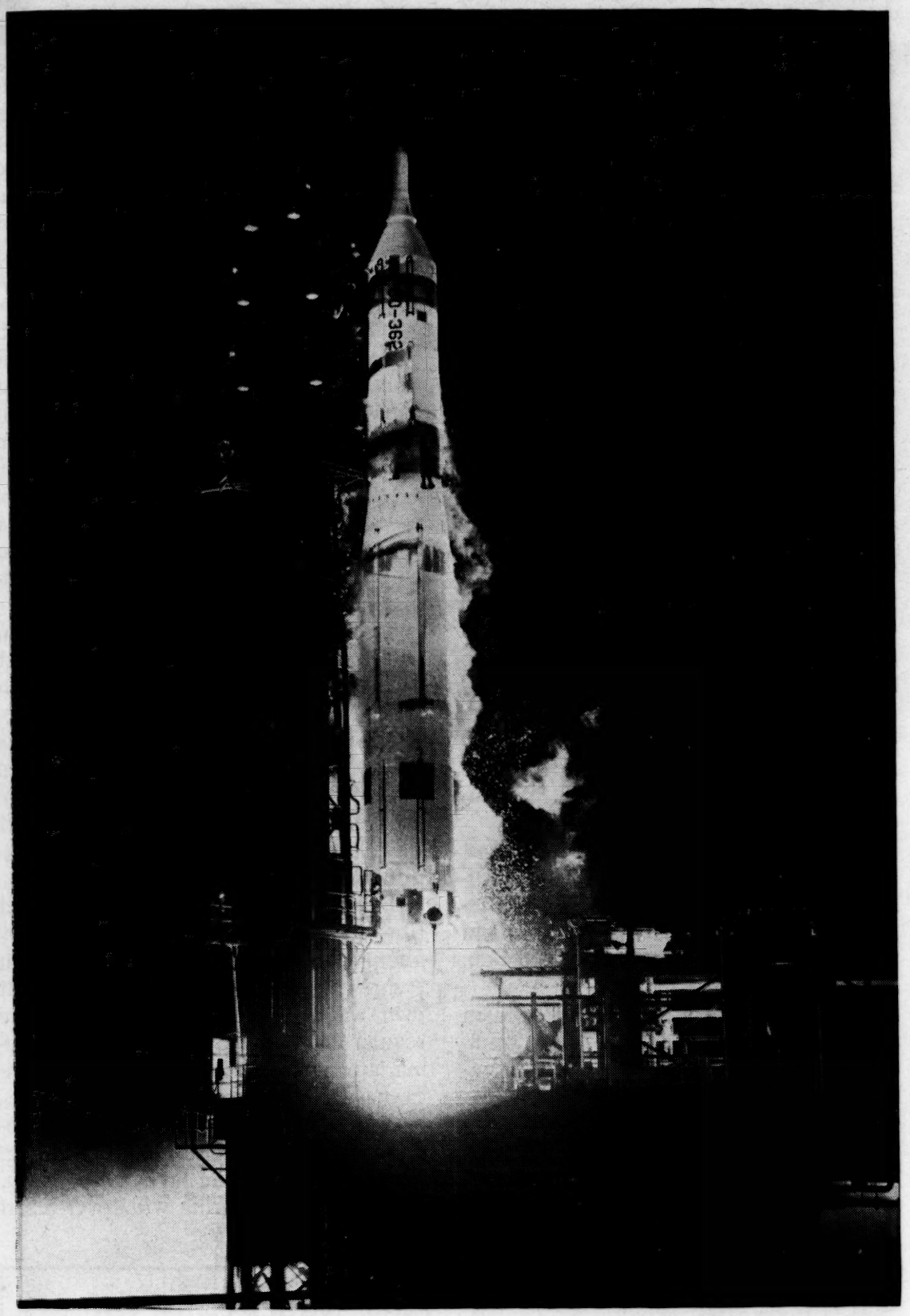
Kennedy on Space

Washington—Soviet Russia's continuing lead over the U. S. in space booster power is "a matter of great concern" and "it is going to be a major task to surpass them," President John F. Kennedy said last week.

"We have sufficiently large boosters to protect us militarily, but for the long heavy explorations into space, which require large boosters, the Soviet Union has been ahead . . ." he said.

"We have made exceptional gains in space technology, which may not be as dramatic as Sputnik or as a probe to Venus but which in the long run does, at least I think should, give all Americans satisfaction in the efforts that we have made," the President said.

"Boosters, however, we are behind on . . . The Soviet Union made a significant breakthrough in this area some years ago, and they have continued to make their lead, and it explains why they were ahead of us in Sputnik and it explains why they have been able to put larger objects into space, and we have to recognize that their chances of continuing to do that, unless we are able to make a breakthrough before the Saturn booster comes into operation, unless we are able to make a scientific breakthrough, we have to recognize that we are in a position, a secondary position on boosters."



USAF-Martin Titan J missile carries General Electric Mark 3 nose cone for first time.

Titan Carries Mark 3 Nose Cone

Washington—USAF-Martin Titan intercontinental missile carried a General Electric Mark 3 nose cone for the first time Feb. 10 in a test of the interchangeability of major ICBM subsystems. The Mark 3 was designed primarily for use on the USAF-Convair Atlas ICBM.

No plans exist now for using the Mark 3 on operational Titans, but goals laid down early in the ballistic missile program require that certain components be compatible with more than one missile. Early USAF-Douglas Thors and early Atlases use the same General Electric Mark 2 heat-sink type of warhead and slightly different versions of the same Rocketdyne engine. The Avco Mark 4 nose cone, designed for the Titan, also will be used on a number of Atlases because it produces a higher explosive yield than the Mark 3.

The Mark 3 was flown 5,000 mi. over the Atlantic Missile Range by a Titan J, which is a prototype of the operational Titan I missile, incorporating a number of simplifications that will appear in the first hard-based squadrons.

Two previous flight tests of the Titan failed, each because the second stage Aerojet engine failed to ignite. So far in the Titan development program, 19 attempts at in-flight ignition of the second stage have been made and 16 have been successful. (For production details of the Titan J see p. 33.)

No specific cause was found for the second stage ignition failure last Dec. 20. Failure last Jan. 20 was caused by a sequencing problem which tests showed was easily corrected.

The missile carrying the Mark 3 cone also provided the first flight test of a 22-million-candle-power strobe light to aid in optical tracking. The light, twice as powerful as any tracking lights used before, was developed for the Titan by Friez Instruments Division of the Bendix Corp.

Caribous and Otters Ordered by Ghana

Ghana has ordered eight DHC-4 Caribou transports and 12 DHC-3 Otter utility aircraft from de Havilland Aircraft of Canada, Ltd. The aircraft and spare parts, to be delivered before mid-1963, will cost the African republic $7,550,000.

Other aircraft ordered by the Ghanaian government for either airline or military use include two Boeing 707-420s, three Vickers VC-10s, six Soviet-built Ilyushin Il-18s, three Vickers Viscount 800s, 14 de Havilland DHC-2 Beavers and 12 de Havilland Chipmunk trainers (AW Dec. 12, p. 39 and Jan. 30, p. 48). Two Bristol Britannias were delivered last November.

The first two Caribous—twin-engine transports with STOL performance—are to be delivered in November. Four more will follow in 1962, and the remaining two will be delivered in early 1963. Ghana air force flight crews will accept delivery at de Havilland's Ontario plant, then fly the aircraft to Accra via the Azores.

The first two single-engine Otters will be shipped to Ghana by sea next month. Balance of the Otter order, worth $1.8 million, is scheduled for delivery before the end of the year.

Ghana intends to equip some of the aircraft with cameras for extensive aerial photo-mapping of its relatively isolated interior. Remaining Caribous, Beavers and Otters will be used for government liaison with outlying areas, air evacuation, welfare work and police patrols.

Scout Launch Fails

Washington—Second attempt to put a 12-ft. inflatable sphere into orbit with a four-stage solid fuel Scout vehicle apparently failed late last week. The rocket's fourth stage went into orbit but signals from the sphere's 136.95-mc. beacon could not be detected. There was a possibility that it was in orbit but that its transmitter was not working. Purpose of the shot was to measure air density. An earlier attempt failed in December (AW Dec. 12, p. 33). Both shots were made from National Aeronautics and Space Administration's Wallops Island Station, Va.

Air Force Routing Troop Airlift To Avoid Cuban Propaganda Risk

Washington—More than 100 troop carrier transports will airlift U.S. Army paratroop units to Panama this week in Operation Solidarity, an exercise that could provide Cuba's Castro government with fresh invasion propaganda material.

Solidarity is one of a series of exercises involving airlift of troops from the continental United States for maneuvers in such diverse areas as Panama, Alaska and the Philippines.

To minimize the possibility of a Cuban incident, the airlift fleet—composed of Lockheed C-130s and Fairchild C-123s and 119s—will skirt the boundaries of Havana's Flight Information Region (HFIR) en route. Within this zone, Cuba controls all aircraft on Instrument Flight Rule clearances.

Since the HFIR blankets all of Cuba and surrounding waters, the relatively short-range Tactical Air Command aircraft must detour up to 500 mi. on the over-water leg from Florida to the Canal Zone. Partly responsible for the extra distance is a Cuban NOTAM (AW Dec. 12, p. 50) banning all U.S. flights from a 30-mi. wide corridor extending into the Caribbean from the island's northwestern tip.

In another exercise, 300 aircraft were engaged in the Philippines last week, carrying and supporting a battle group of the Strategic Army Corps. Conducted in the Clark AFB-Stotsenberg training area, Exercise Long Pass is designed to test and improve U.S. capability for moving air and ground forces to such trouble spots as Laos and for supporting their operations.

First phase of Long Pass began last week as 128 military transports carried troops from the United States and the Pacific area to the Philippines. Joint air and ground operations are to follow this week, with 92 Tactical Air Command aircraft dropping assault troops and providing close air support. Of 300 aircraft participating, 200 are from the continental United States and 80 from Pacific Air Command.

In Exercise Willow Freeze, about 3,500 troops of the 82nd Airborne Division were trained in the airborne reinforcement of the Alaskan Command during a 10-day project that ended Feb. 19.

Called Banyan Tree last year and in 1959, Operation Solidarity is a simulated Strategic Army Corps airborne assault on any enemy position.

Basically, it is to test paratroop combat capability, but because Albrook AFB, staging area for the exercise in Panama, is more than 1,400 naut. mi. from the continental United States along the routes to be flown, Solidarity also is viewed as a mobility trial for TAC's troop carrier wings.

Operation Solidarity marks the first implementation of a policy under which reserve troop carrier wings on annual training tours will be mixed with regular Air Force airlift units in joint maneuvers. An outgrowth of the USAF reserve reorganization last summer, this new approach will make practical use of the 15 troop carrier reserve wings' airlift capability when they are mobilized for their annual active duty tours. These tours formerly were devoted to training.

Airborne contingents from Panama, Colombia, Brazil, Peru and Chile will join in Solidarity by jumping alongside soldiers of the U.S. 82nd Airborne Division. This broad inter-American participation in a hemispheric defense exercise sponsored by the United States is significant in view of recent Cuban attempts to foment revolutionary movements in two of the nations involved in the maneuver, Peru and Colombia.

The first potential incident arising out of Operation Solidarity occurred Feb. 3, when the pilot of a C-119, operated by the 514th Troop Carrier Wing at Mitchell AFB, N. Y.—the only Air Force Reserve unit participating in the exercise—filed an IFR clearance from Homestead AFB, Fla., to Panama on a pre-exercise flight. The transport's routing would have penetrated the edge of the HFIR.

Flying away from the Florida coast, the pilot was informed by Miami air traffic control center that his flight plan was unacceptable to Cuban air traffic control authorities. Miami then relayed a revised routing furnished by the Havana center. This new clearance called for a direct course to the Havana radio beacon where the pilot was to cross the Cuban mainland before turning south toward Panama.

The Havana clearance, which ran counter to an Air Force policy against flying over Cuban territory, was rejected, and the pilot returned to Homestead. Later, Air Force revised the route the Mitchell AFB C-119s had been scheduled to take across the Caribbean. By following this new course, aircraft stay clear of the Havana Flight Information Region.

But at the same time, C-119 flight time to Panama has been extended by about 2 hr. and now entails more than 9 hr. of nonstop, twin-engine flight over water. In order for shorter-range regular Air Force C-123s to reach Panama, a refueling stop at Kingston, Jamaica, has been scheduled.

Adding to the variety of training programs will be Exercise Denning Spring, which will be held at Camp Irwin, Calif. Denning Spring will cover desert operating techniques.

General Dynamics Writes-off Jet Costs

New York—Costs of its Convair 880M and 990 jet transport program have forced General Dynamics Corp. to make additional write-offs in the fourth quarter of 1960 after advising stockholders in the third quarter that a $96.5 million pre-tax write-off at that time would cover all future anticipated charges (AW Oct. 3, p. 47).

In a terse letter to stockholders, much in contrast with the tone of the usual General Dynamics quarterly report, Chairman Frank Pace said that neither the 880M nor the 990 had been flight tested when the third quarter report was written.

Since then flight tests have indicated costs substantially above earlier estimates would be required for unspecified modifications. Probably these are flight controls.

These costs will absorb what otherwise would have been fourth quarter earnings. As a result, the net loss for the year will roughly equal the $26 million reported in September, Pace said, and he concluded:

"Despite the many accomplishments achieved by General Dynamics during the year, the effect of the jet transport program has made the year 1960 a most disappointing one."

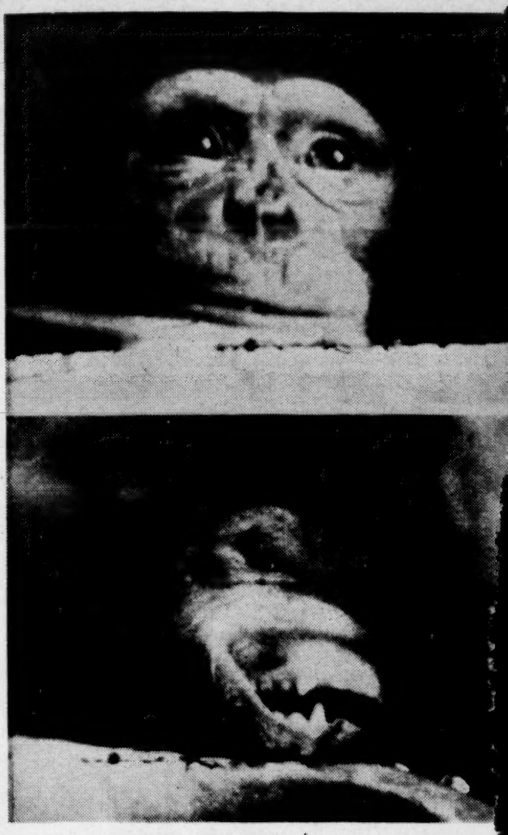
Piper Sales Off

First quarter sales of Piper Aircraft Corp. were 19% below sales for the same October-December period last year. Sales of $8,687,332 produced a first quarter net income of $.24 per share, compared with last year's first quarter income of $.78 per share.

Charles W. Pool, company treasurer, attributed the decrease primarily to the depressed condition of the economy. High early production and initial costs at the company's new Vero Beach, Fla., plant, where the Piper Cherokee (AW Jan. 9, p. 101) is going into production, contributed to the lowered earnings.

Production at the Lock Haven, Pa., plant is being advanced this month from 8½ to 12½ planes per day as a result of increased sales of the low-priced Piper Colt (AW Nov. 21, p. 106).

Lower profits for the current year had been forecast earlier by the company (AW Jan. 16, p. 27).



MR-2 Chimpanzee

Chimpanzee passenger in second Mercury-R undergoing a flight load of 17g for about Photos were taken from 16 mm. motion

British Defense P
Stress on Nuclear

London—British government's annual defense white paper, published last week, stated that Britain would continue to rely on planes carrying nuclear weapons as its main contribution to the Western deterrent over the next decade.

To counter defensive improvements, improved Mark 2 versions of present V-bombers would be given increased "stand off" capability, while the bomber command hoped to get combinations of missiles to carry British-made warheads to targets from American and British bases, the report said.

The report referred to planes designed for low-flying attacks (apparently the Vickers-English Electric TSR.2 and the Blackburn Buccaneer) but mentioned no new weapons for the RAF.

Defense budget for 1961-62 totaled $4.634 billion, an increase of $109.2 million over the previous year's and more than a quarter of all government expenditures.

Because a $33.6 million West German contribution to defense costs is no longer forthcoming, the increase will cost taxpayers $142.8 million. In addition $52.1 million will be spent on civil defense, a rise of over $9 million.

Although over-all defense spending will rise, the defense budget will absorb slightly smaller proportions of the gross

Rep. Daddario heads the House space subcommittee dealing with patent provisions and has been pushing for basic changes in the law which gives the government title to inventions made under government contract. He said revision to this NASA patent policy should encourage wider participation in the space effort.

As a starting point toward a more vigorous program, Rep. Daddario suggested that NASA revise its manned lunar landing timetable from the 1970s to 1969, when the moon will be in its best inclination.

"This [1969] is an optimum for a shoot at the moon—but the Russian thrust capability permits them to pick their own time. In 1967, it will be the 50th anniversary of the Bolshevik revolution. Here they will have a clear choice between a calm, scientific appraisal of the best time, and the practical prospect of pragmatic propaganda. They have already said they'll be shooting for the earlier date."

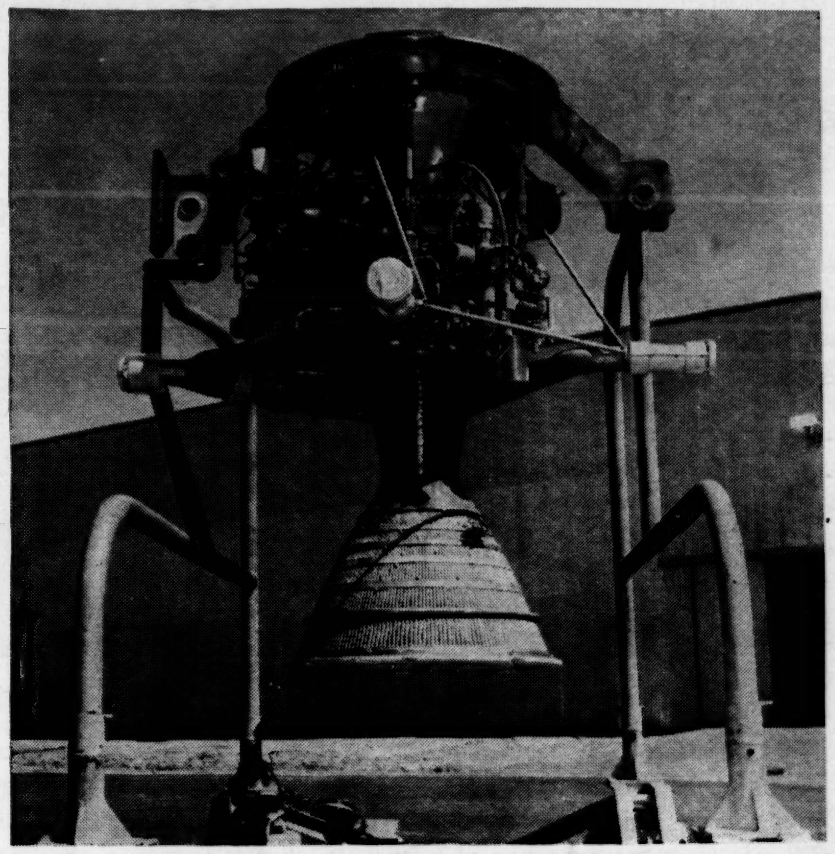
Republicans Appointed To House Committees

Washington—Republicans last week assigned Rep. Jessica McC. Weis (R.-N. Y.) to the House Committee on Science and Astronautics. She is the first woman to serve on this committee.

Also named to the House space committee by Republicans were Reps. Charles A. Mosher (R.-Ohio), Richard L. Roudebush (R.-Ind.), and Alphonzo E. Bell, Jr. (R.-Calif.).

New Republican members assigned to other House committees include the following:

- **Appropriations**—Reps. William H. Milliken, Jr., (R.-Pa.) and Earl Wilson (R.-Ind.).
- **Armed Services**—Reps. Alexander Pirnie (R.-N. Y.); Durward G. Hall (R.-Mo.); Donald D. Clancy (R.-Ohio), and Robert T. Stafford (R.-Vt.).
- **Foreign Affairs**—Reps. Peter Frelinghuysen, Jr., (R.-N. J.); William S. Broomfield (R.-Mich.); Robert R. Barry (R.-N. Y.); J. Irving Whalley (R.-Pa.), and Horace Seeley-Brown, Jr., (R.-Conn.).
- **Government Operations**—Reps. John B. Anderson (R.-Ill.), Richard S. Schweiker (R.-Pa.), and F. Bradford Morse (R.-Mass.).
- **Interstate and Foreign Commerce**—Reps. Willard S. Curtin (R.-Pa.), Abner W. Sibal (R.-Conn.), and Vernon W. Thomson (R.-Wis.).
- **Judiciary Committee**—Reps. Garner E. Shriver (R.-Kan.); Clark MacGregor (R.-Minn.); Charles McC. Mathias, Jr., (R.-Md.); James F. Battin (R.-Mont.), and James E. Bromwell (R.-Iowa).
- **Post Office and Civil Service**—Reps. John H. Rousselot (R.-Calif.).



MODIFIED second stage Titan J rocket engine features an ablative nozzle extension and has an area ratio of 25:1. Before uncooled skirt is added, the thrust chamber (right) has an area ratio of 13:1.

Ablative Skirt Added To Titan J Series

Ablative skirt has been added to the Titan second stage rocket engine to simplify launch operations and increase reliability.

The first modified Aerojet engines are being used in the Titan J series, permitting the missile second stage to make a "dry jacket" altitude start. Previous second stage Titan engines featured "wet jackets" or regeneratively-cooled nozzles.

In addition to complicating prelaunch operations, this procedure allowed for contamination of the engine compartment from fuel leakage during first stage operation.

With the modified engine, the Titan now leaves the ground with the second stage engine cooling tubes empty. The reduced volume of the second stage thrust chamber cooling passages makes it possible—that is, allows enough time—for the tubes to be filled in flight just before stage separation and second stage ignition.

The earlier Titan second stage engines had regeneratively-cooled nozzles with area ratios of 25:1. Aerojet engineers, in effect, cut the regeneratively-cooled nozzle back to a point where the area ratio became 13:1 and added an uncooled, ablative skirt to bring the area ratio back up to 25:1. The skirt consists of an asbestos-reinforced phenolic liner stiffened by glass fiber-reinforced phenolic honeycomb.

Solar Energy Thermionic Converter

Pasadena, Calif.—Jet Propulsion Laboratory briefed industry last Thursday on its requirements for flight prototype of a solar energy thermionic conversion system capable of satisfying prime electrical power needs of space vehicles. The laboratory is seeking a device which will supply 130 w. of power for a space vehicle operating near the planet Mars.

A contract for the design, fabrication and testing of such a converter will be awarded sometime after proposals are due here on Mar. 12. The estimated dollar value of the Jet Propulsion Laboratory contract will be approximately $250,000.

Thermionic conversion is one of several promising techniques for converting heat directly into electrical energy (AW Aug. 15, p. 83). JPL is asking industry for a device which will collect the sun's energy with a 5-ft.-dia. collector. It would then focus the sun's energy through the aperture of an absorber containing cesium thermionic diodes. When properly heated, d.c. current flows through the diode to an electrical load, thereby converting heat into electrical energy.

A spokesman for the laboratory here said that the prototype will be used for extensive environmental testing on the ground to determine the reliability of such a system for space applications. An actual flight system, JPL hopes, would be similar to the prototype and might consist of several such units for increased power.

Europeans Set F-104 Production Schedules

Bonn—Multi-nation European production program for the Lockheed F-104G all-weather fighter is scheduled to hit a peak rate of about 32 aircraft per month by late next year under present plans and continue at this rate until late 1964, when a total of 949 Super Starfighters will have rolled off the line (AW Jan. 16, p. 32).

All-German southern group of Messerschmitt, Heinkel, Dornier and Siebel is pushing to reach a rate of six airframes per month by November. Initial aircraft will be largely produced from fuselage sections and components supplied by Lockheed. Over-all, the southern group is to produce a total of 210 F-104s under the program as it now stands.

Northern group headed by Holland's Fokker and including Aviolanda and the German firms of Focke-Wulf, Hamburger Flugzeugbau and Weser Flugzeugbau will begin production late this month, again relying primarily upon Lockheed-supplied parts. It will reach a peak of 14 airframes per month by next spring.

Production-goal for the group has been set at 375 airframes.

Italy's Fiat and Belgium's Societe Anonyme Belge de Constructions Aeronautiques (SABCA) are still tooling but are expected to be rolling out approximately six aircraft each per month by late 1962.

Each has been assigned production of 182 aircraft under the multination program.

Nord Testing SS-12 Tactical Missile

Nord Aviation SS-12 tactical missile (AW June 27, p. 29) has a larger warhead than company's SS-10 and SS-11 models, and is provided with radio link guidance system in addition to wire guidance. SS-12, still undergoing company tests, has ground-to-air range of 3.8 mi., air-to-ground range of over 6 mi. Latter version is designated AS-12. Dimensions include length, 5 ft. 3 in.; diameter, 7 in.; span, 2 ft. 2 in.; total weight is 165.4 lb. Below, Italian army team carries disassembled SS-11s, in a winter operational exercise.

Scout to Obtain Snap 8 Design Data

Fifth Scout payload will be instrumented to measure the effects of micrometeorite activity to obtain basic data for structural design of the radiator for the Snap 8 reactor system.

Integrity of the Snap-8 radiator in space is a major design problem because of its large size and the uncertainty of the effects micrometeorites will have on it, according to Dr. Fred Shulman, nuclear propulsion program manager for the National Aeronautics and Space Administration. Radiator area will be at least 300 sq. ft., and it will be the largest single component in the system.

The Scout 5 satellite, designated S-55, is scheduled to be launched from Wallops Island, Va., during the second quarter of this year. The 115-lb. package will measure velocity, size and frequency of micrometeorites in an orbital apogee of 740 mi., perigee of 280 mi.

Shulman told a joint meeting of the Society for Nondestructive Testing, Inc., and Southwest Research Institute, last week in San Antonio, that the Snap 8 reactor will be less than 2 ft. in diameter, and the entire rotating machinery package will be three feet long.

He said the outlook for nuclear energy in space has never looked better than it does now, and that the program is "essentially on schedule." NASA's long-range plan calls for first test flight of a nuclear rocket vehicle in 1966-67.

He said NASA missions require more powerful boosters than are presently needed by the military, and it is "obvious that the era of the inheritance of launch vehicles from the Department of Defense is rapidly growing to a close . . ."

This chronology of the nuclear rocket program was outlined:

- **Demonstration of feasibility** of nuclear rocket engines by ground firing, which began with the Kiwi-A series in which three successful tests were conducted using gaseous hydrogen as working fuel and water as nozzle coolant. The Kiwi-B series, to begin this year, will use liquid hydrogen as fuel and coolant.
- **Development of high power** density reactors for high thrust rocket engines to be used in interplanetary missions.
- **Continuous advanced research** for reliability.

Shulman told the session that considerable progress in the nuclear program already has been achieved, including identification of long-lead time items, formation of a combined NASA-Atomic Energy Commission-industry management group, construction of the sodium-potassium and mercury pumps and mercury boiler by Aerojet, and design of the reactor by Atomics International. Bids recently were invited for development of a full-scale flight-rated nuclear rocket engine, to be called Nerva (AW Feb. 6, p. 35).

Five VATE Study Contracts Awarded

Five avionics firms were awarded parallel study contracts recently to develop specifications for automatic computer control of the Air Force's inertial guidance depot at Heath, Ohio. The five are Arma Division of American Bosch Arma Corp., Hughes Aircraft, International Telephone and Telegraph, Lockheed Missiles and Space Division and Sperry Gyroscope.

The project, known as VATE (Versatile Automatic Test Equipment), aims at more efficient check-out and maintenance of inertial systems for the Air Force's Minuteman, Skybolt, Hound Dog, Atlas and Titan missiles.

About 73 companies had attended the Air Force briefing on VATE in Dayton last fall (AW Nov. 28, p. 91). Study contracts were awarded by Gentile Air Force Station.

Kennedy Names Four Consultants On Organization of Government

Washington—President John F. Kennedy replaced two advisory committees on government organization and management improvement with four individual consultants last week.

The consultants will not act as a committee nor will they hold regular meetings, but they will be consulted individually on major issues affecting the structure and operations of the government. They are:

- **Robert A. Lovett,** former secretary of defense and under secretary of state in the Truman Administration.
- **Richard E. Neustadt,** professor of government at Columbia University, who also served as President Kennedy's special consultant on organizational matters between the election and inauguration.
- **Don K. Price,** dean of the graduate school of public administration, Harvard University.

"The consultants named," he said, "are exceptionally well equipped to help us conceive and carry through the necessary adaptations in timely and orderly fashion."

President Kennedy said he would terminate the Advisory Committee on Government Organizations, which was created in 1953, and also the Advisory Committee on Management Improvement, which was established in 1949 but which has not functioned since 1952. Other appointments include:

- **Lt. Gen. James Gavin** (USA Ret.), president of Arthur D. Little Co. and former chief of the Army's research and development, as ambassador to France.
- **Stephen Ailes,** a Washington, D. C. lawyer, as under secretary of the Army.
- **David L. Ladd,** Chicago lawyer, as commissioner of patents.

Defense Secretary Robert McNamara made these shifts in the Defense Department:

- **Paul H. Riley,** special assistant to the assistant secretary of defense for supply and logistics, as deputy assistant secretary for supply and services.
- **Edward J. Sheridan,** director of construction in the office of the assistant secretary for properties and installations, as deputy assistant secretary for properties and installations.
- **Graeme C. Bannerman,** director of the office of procurement policy, supply and logistics, as deputy assistant secretary for procurement.
- **Glenn V. Gibson,** special assistant to the secretary of defense, as deputy assistant secretary for requirements and readiness planning.
- **Eugene H. Merrill,** director of NATO's construction program, as deputy assistant secretary of the Army for logistics.

Defense Department is abolishing the offices of the Army and Navy assistant secretaries for manpower, personnel and reserves, and these areas will be the responsibilities of the two services' under secretaries. The comptroller and fiscal responsibilities of the under secretary of the Navy will be transferred to the new office of assistant secretary for financial management.

Aerospace Corp. May Triple Staff

El Segundo, Calif.—Aerospace Corp., probably will more than triple its present technical staff of approximately 400 within the next year, to meet new project responsibilities and expand present program activities.

Recent changes in Aerospace's board of trustees include election of William C. Foster, vice president and director of Olin Mathieson Chemical Corp., who succeeds Roswell L. Gilpatric as chairman of the board of Aerospace Corp. Gilpatric resigned to accept his appointment as deputy secretary of defense.

Dr. Harold Brown, director of University of California's Lawrence Radiation Laboratory, also was elected to the Aerospace board of trustees, to replace Dr. Chalmers W. Sherwin, who continues as vice president and general manager of Aerospace's Laboratories Division.

Dr. Jerome B. Wiesner also has resigned from the Aerospace board to assume the position of special assistant to the President for science and technology.

Najeeb E. Halaby, new administrator of the Federal Aviation Agency, has resigned as secretary of Aerospace Corp.

News Digest

Elwood R. Quesada, former Federal Aviation Agency administrator, has been named a director of American Airlines. James H. Douglas, former Air Force secretary and deputy secretary of defense, is returning to the American board of directors.

Speedball Nike Zeus target vehicle was launched to an altitude of 155 mi. at White Sands Missile Range last week in its first flight. The two-stage solid fuel rocket vehicle will be used to test Zeus acquisition and tracking radars at White Sands, and it will be used at Kwajalein atoll as a target for Nike Zeus test flights.

The Martin Co. has purchased 90,000 shares of Epsco, Inc., a Massachusetts company engaged in the development of high-speed data control systems. Epsco's 1960 sales were about $11 million. Martin bought the unlisted shares for investment purposes, owns about 15% of the outstanding shares, which are unlisted.

Ion-beam projector type aerospace defensive weapon system feasibility study will undergo continued experimenting by USAF Air Proving Ground Center, Eglin AFB, Fla., under a $229,686 contract awarded General Electric Co.'s technical military planning operation (Tempo), Santa Barbara, Calif. System, popularly termed "ray guns," is being studied by APGC's directorate of development.

Air Force Research and Development Command twice successfully launched its air-to-surface missile, the GAM-83B Bullpup from North American F-100 Super Sabres over the Gulf of Mexico.

Estimated earnings of $1,301,820 in the last eight months of 1960 by Braniff Airways wiped out losses of $581,260 during the first four months and resulted in net earnings for the year of $720,560, equal to 24 cents per share.

Improved Terrier air defense missile has been test flown at Naval Ordnance Test Station with a new, high performance solid rocket sustainer developed by Atlantic Research Corp.

Federal Aviation Agency will make it mandatory for pilots to report malfunctioning airborne navigation equipment to an appropriate air traffic control facility.

B-52G Wing Change

Boeing B-52G Stratofortress bombers are undergoing a wing-strengthening modification in the field as the result of a problem that came to light during a cyclic test program.

The modification, which is believed to be the area of the wings between the inner pair of engine pods and the fuselage, is also being incorporated on the newer B-52H, which is scheduled for delivery to Strategic Air Command later this year. Modification work on all B-52Gs is being accomplished by teams of Boeing-Wichita and USAF personnel under the Skyspeed modification concept and the company anticipates that the program will be completed by May 1. Necessary changes already have been completed on a number of aircraft.

White House Transpacific Review Likely

CAB appears certain to send route case to Kennedy; final decision would shed light on new air policy.

By L. L. Doty

Washington—White House review of the controversial Civil Aeronautics Board Transpacific Route Case, which will shed the first light on the international civil aviation policy the Kennedy Administration will follow, now appears inevitable.

Petitions to the CAB last week asking for reconsideration can be handled in a number of ways, but chances are strong that the Board will ask the White House to reconsider its original decision or will reconsider the case itself and submit its new decision to the White House for final approval.

Possibility of both the White House and the CAB refusing to reconsider the issues at stake are not likely in view of the accelerated action President Kennedy is urging in foreign and economic matters and because all participating members of the Board dissented on at least one point in the original decision. The new composition of the Board (AW Feb. 13, p. 40) undoubtedly favors reconsideration.

Although it is too early to determine the policy the new Administration will follow in resolving the case, AVIATION WEEK has learned that initial thinking on international civil aviation, particularly on negotiation of bilateral air transport agreements, follows this pattern—providing a clue to how the Kennedy staff will react to the transpacific issues:

- **Well defined U. S. policy** to serve as a guide in the allocation of foreign routes will be set, with the White House restricting its decisions to the foreign relations area. However, close liaison will be maintained with the Board as a means of preventing conflicts between economic and foreign relations.
- **United States will take a strong stand** against foreign governments' efforts to restrict capacity, schedules or traffic of U. S. carriers. At the same time, it will ease its pressures for curtailment of Fifth or Sixth Freedom traffic handled by foreign flag carriers.
- **Multi-designation or competition** between U. S. flag carriers on international routes will be continued as a basic principle of U. S. policy. There is no indication that the Kennedy Administration will adopt recommendations of United Research, Inc., suggesting that the number of carriers assigned to a given route be determined by the volume of traffic available.
- **State Department will continue** to handle all bilateral negotiations, with the White House approving only major points raised during bargaining. Under the Eisenhower Administration, State negotiators were required to clear all issues, major and minor, with the White House as they arose.

The CAB decision in the Transpacific Route Case was disapproved by former President Eisenhower during the closing hours of his Administration (AW Jan. 30, p. 38). His refusal to approve the Board's recommendations for a number of new routes throughout the Pacific, reportedly a reversal of an earlier decision, was founded on his prediction that the action "would unsettle our international relations—particularly with Japan which would be faced with an additional U. S. carrier on all but one of the now existing four routes from the U. S. to Tokyo."

There is no sign, however, that the Japanese government has made any move toward opposing further Board action in the case, and Japan Air Lines has stayed clear of the case and apparently is not immediately concerned with the outcome.

Nevertheless, if a decision to expand routes of U. S. carriers in the Pacific is made, it is quite possible that Japan will take steps to prevent implementation of the new services as a bargaining weapon in its drive for landing rights at New York and rights to fly beyond to London, an indispensable segment in its proposed around-the-world route. R. Itoh, Japan Air Lines executive director, is now here on informal talks with State on the New York stop.

Although Eisenhower's decision in the transpacific case would suggest that his Administration was confining action on route cases to the foreign policy issues involved, the President made this statement in 1957:

"It is this Administration's objective, wherever traffic justifies it, to provide competitive United States service on all international and overseas routes from all gateways."

White House disapproval of the Transpacific Route Case decision was the fifth time that Eisenhower disapproved or overruled Board recommendations in the continuing controversy over Pacific routes. On one occasion, he reversed a Board recommendation and then partially reversed his own decision.

At that time, he overruled a Board decision that Northwest be given a permanent route between Seattle-Portland and Honolulu and that Pan American's authority to serve this route not be renewed. Only 32 days later, the President, publicly acknowledging that he had originally received erroneous information, directed the Board to authorize temporary certificates for both carriers on the route.

Both Pan American and Northwest, chief contenders in the current case, filed petitions for reconsideration along with a majority of the other applicants and intervenors in the case, charging that Eisenhower acted on incorrect information on certain points in making his decision.

Pan American discounted Eisenhower's fears that the Board's recommendations would have an adverse effect on foreign relations as "wholly unfounded." The carrier urged the Board to resubmit its original decision to the White House now that Kennedy has taken office and said that the delay of several years recommended by Eisenhower would seriously and permanently hamper U. S. flag carriers in the Pacific.

The airline emphasized that major inroads have been made competitively by British Overseas Airways Corp. and Qantas Empire Airways on Pacific routes and said that their superior route patterns already have an adverse effect on Pan American. The carrier made a strong bid for the routes recommended by the Board in its original decision which was rejected by Eisenhower.

Northwest will fight moves to get the Board's original decision approved since it grants a route to Pan American paralleling its northern Pacific route. It also objects to Pan American's proposal to have Boston, Philadelphia, Baltimore, Washington, Detroit and Chicago included as co-terminals on Pan American's Pacific route. Northwest claimed in its petition that the Board incorrectly informed the President on the need for more Pacific routes.

United Air Lines' Caravelle VIR Flight Trial

First United Air Lines Caravelle VIR was flown last week in preparation for its delivery in April or May. The balance of United's Caravelle order, 20 aircraft, is scheduled to be delivered by January, 1962. This Mark VIR version is powered with Rolls-Royce Avon 532R turbojets delivering 12,375 lb. thrust with thrust reversers. Later engines, incorporating turbine blade modifications, will be designated the Avon 533R (AW Aug. 8, p. 53). Maximum authorized takeoff weight is 100,000 lb.

State-Owned Air Ferry Urged for Hawaii

Honolulu—Proposal to establish a state-owned air ferry service connecting the six main Hawaiian islands was supported by Aloha Airlines and opposed by Hawaiian Air Lines at legislative hearings here last week.

At issue is the question whether Hawaii should adopt the recommendations of an independent survey, authorized last year, that the state buy three Armstrong Whitworth AW 650 turboprop aircraft for subsidized operation by one of the two airlines.

The $170,000 transportation survey, prepared for the State Planning Office by Law & Wilson, Tudor Engineering Co. and Frank Der Yuen of Lockheed Air Terminals, Inc., urged the purchase as an initial step toward strengthening Hawaii's internal economy by providing faster and more economical means of transportation for passengers and cargo between Oahu and the islands of Kauai, Molokai, Lanai, Maui and Hawaii.

Further consideration of the plan, basically supported by Aloha and rejected by Hawaiian is scheduled this week by the State Planning Office, which will make a formal recommendation on the proposal and on alternatives suggested by Hawaiian to the State Senate Economic Development, Tourism and Transportation Committee.

Three AW 650 turboprop aircraft, designed for short-haul service and combination passenger and freight loads, could be purchased for $6.5 million with the expectation of providing subsidy-free service by 1969, the survey said. During the first six years of service, the survey estimated the air ferry system might require $2.8 million in subsidy, most of which would be offset by an estimated $2.3 million it would produce in tax revenues for the state.

Suggested service pattern of the system totaled 115 weekly round trips among the islands, with the majority of them connecting Oahu with Kauai and Hawaii. Based on this volume of service and the AW 650 design, the survey said passenger fares could be 10% lower than existing inter-island air fares, but cargo rates might remain at their present 47 cents a ton mile level. Daily utilization of the aircraft could be increased by transporting cargo and cars at night.

Recommending that the state legislature authorize a $6.5 million general obligation bond issue to finance purchase of the aircraft, the survey said that bidding on the air ferry system operation should be open only to Aloha and Hawaiian, with other qualified operators considered only if the two carriers fail to offer suitable proposals.

Orders for the three aircraft should be placed by Jan. 1, 1962 and a contract signed six months later to receive the first AW 650 by July 1, 1963, a second on Oct. 1, 1963 and a third on July 1, 1964, the report said. First of the two aircraft would be current production models designed to carry a 14-ton payload about 600 mi., with a typical loading of two full-size cars, 14 passengers and cargo. The third aircraft, the AW 670, which is not yet in production, would carry 30 passengers on an upper deck, plus six standard cars and cargo on a lower level, the survey said.

Aloha Airlines, which announced a month ago that it has been studying the feasibility of an air ferry system for more than a year, termed the proposal "reasonable" and expressed confidence that it is the "best solution" to the economic development problem of the islands. Pointing out that it had originally intended to purchase its own AW 650s for air ferry use, the airline suggested it finance the purchase of the aircraft under a loan guarantee agreement with the state, in addition to receiving subsidy payments, as a means of relieving the government of the need to authorize a bond issue.

The legislators rejected Aloha's offer to finance the aircraft purchase, pointing out that whether arranged by bond issue or loan guarantee, the state would still be faced with responsibility.

Strongest opposition to the state proposal came from Hawaiian Air Lines, which handles 95% of the inter-island freight traffic. Calling the survey study a "hodge podge of bad and unproven assumptions," Hawaiian said it doubts that the aircraft selected can produce an economical operation without subsidy.

Survey recommendations that only Aloha and Hawaiian be permitted to bid on the air ferry service put Hawaiian in the position of bidding on its own "cargo life," the airline contended. Award of the service to one carrier might also result in a heavy subsidy increase by the remaining airline, Hawaiian said, which might raise strong objections from the federal government. As an alternative to the entire state proposal, Hawaiian suggested:

- **State subsidy** should be paid to develop low cost general air freight system.
- **Inter-island carriers** should be paid a subsidy for the shipment of specific commodities, such as vegetables.
- **A general subsidy** payment should be made by the state to existing carriers as a means of producing lower air fares, using cheaper aircraft in an air-bus type of service.
- **Money which the state** air ferry plan would cost should be spent by Hawaii to develop resort areas on outlying islands as stimulant to the tourist trade.

Hawaiian told the legislature it will produce detailed studies within the next month on its recommendation for subsidy for low cost passenger and freight services.

IATA Cargo Split Paves Way For Open Rates on North Atlantic

International Air Transport Assn. traffic conference broke up in deadlock last week, paving the way for an open-rate situation for cargo traffic moving across the North Atlantic.

Chief point of contention during the three-week conference was the method of introducing lower cargo rates, which the majority of carriers favored, with respect to volume breakpoints. Generally, the conference was split between U. S. carriers who want rate cuts across the board at progressively higher volume breakpoints and other airlines who want lower rates within a system of commodity classification based on the existing structure of specific commodity rates.

At no time did the conference come close to reaching a unanimous agreement on either a new rate structure or a compromise on volume breakpoints. Since present rates expire Apr. 10, an open-rate situation will exist thereafter, unless the governments involved intervene to negotiate a cargo rate structure on the North Atlantic.

Cargo rate patterns in Europe, the Middle East and Africa—only areas other than the North Atlantic which were still undecided—were settled without change.

Pan American and TWA bitterly opposed the specific commodity rate system and backed the volume discount or weight-break system. According to Willis G. Liscomb, Pan American vice president, cargo rates based on weights rather than commodities have been used in Latin America for a number of years and in the Pacific area since Jan. 1, 1960, to provide rate reductions up to 50% on general air freight shipments between the U. S. and the Far East.

Here are examples of the rate structure Pan American will introduce on the North Atlantic after Apr. 10 if there is an open-rate situation:

- **Shipments under 45 kg.** will be reduced from $2.81 to $1.90 per kilogram (about 2.2 lb.), for a 32% reduction.
- **Shipments between 100 and 250 kg.** will be sliced from $2.11 to $1.14, for a 46% reduction.
- **Cargo weighing between 250** and 500 kg. is to be reduced from $2.11 per kilogram to $1.10, and shipments between 1,000 and 7,500 kg. to be dropped from $1.83 to 95 cents per kilogram. All shipments over 7,500 kg. will cost 68 cents, compared with the previous rate of $1.83 per kilogram, a 63% reduction.

TWA plans to reduce its rates on the weight-break system but to complement the structure with a commodity rate system for specific goods to create new traffic from shipments which normally have not been moved by air in the past. Rates approximate those offered by Pan American, which, according to L. P. Marechal, TWA sales vice president, will increase present transatlantic cargo traffic 100% during the next two years.

Seaboard & Western was one of the strongest backers of the volume rate system because of the high capacity of its Canadair CL-44 turboprop transport fleet, which it plans to introduce on the North Atlantic in June. Seaboard, however, also wanted to continue a modified system of commodity rates.

This combination of commodity rating and volume discount systems was proposed as a compromise between the two opposing factions by Hans Aeppli, vice president of Swissair and chairman of the IATA traffic conference. Most carriers were inclined to adopt the proposed compromise, but during the discussion, some 30 conditions or additions to the basic proposal made it controversial.

British Overseas Airways Corp. was a strong proponent of a lower over-all cargo rate level and will probably adopt a schedule similar to that being introduced by U. S. carriers once it has received approval from the British government.

Gilbert Lee, BOAC's commercial director, said the airline supports the greatest possible simplification and streamlining of new traffic as the only means of filling the high cargo capacity of its turbojet fleets.

Some carriers violently opposed to volume discounts apparently favor a delay in any real cargo breakthrough until they have the capacity to profit fully from it. KLM generally supported the U. S. position, and Lufthansa held a flexible position throughout the conference.

Main opposition to the U. S. position came from Alitalia, Iberia and Sabena. Air France was conciliatory toward U. S. views during the opening days of the conference, but apparently leaned toward the opposition as the meeting progressed.

Failure to reach an agreement broadened the split between large and small carriers which has been growing within the traffic conference since the Cannes meeting collapsed in deadlock in 1958 over whether surcharges should be applied to seats on turbojet flights. Since then, the conference has continually wrangled over a number of other issues, bringing about extra meetings and long-drawn-out sessions at great expense to the carriers involved.

Many observers are concerned that the IATA structure is threatened by these widespread disagreements and that the time will come when the establishment of passenger and cargo tariffs will be taken over by governments through negotiations on a bilateral basis. If this does happen, IATA would become an organization with little practical purpose, since its basic reason for existence lies in the rate-making functions of its traffic conferences.

It is now considered unlikely that any attempt will be made to follow the conference here with an auxiliary meeting in hopes of reaching some agreement on cargo rates in the North Atlantic area.

It is highly possible, however, that if a rate war on the North Atlantic ensues, governments will take action to reach some settlement to stop price-cutting.

Sabena 707 Crash

Brussels—First passenger fatality aboard a Boeing 707 jet transport in more than two years of regular service was registered last week when a Sabena Belgian World Airlines 707-320 plowed into a field approximately 2.5 mi. from the end of the runway at Brussels Airport after a missed approach following a flight from New York.

Preliminary reports indicated that the crew, which was making a go-around following a missed approach caused by traffic on the runway, had retracted the landing gear but that the flaps were still in a half-down position. The elevator trim tab reportedly was found to be indicating full nose-up trim. Such a condition, if verified, may have been caused by a runaway electric trim tab motor. Normal position for the elevator trim tab during the initial stages of a go-around procedure would be near neutral or a few degrees nose-up trim at most.

Although details from eye witnesses were conflicting, Sabena spokesmen said last week that the aircraft apparently made "at least one attempt" to land, pulled up, made "one very sharp turn" at low altitude and was in the process of making another when it fell into a 45-deg. dive, crashed and exploded on impact. Weather at the time of the accident was described as "good."

A total of 73 persons were killed in the accident.

The aircraft, one of three 707-320s bought by Sabena, had been modified with a ventral fin and enlarged rudder (AW Feb. 6, p. 43). Flight recorder aboard the aircraft has been recovered with its tape apparently intact. Tapes of the tower conversations with the aircraft were impounded by the Belgian government.

FAA Is Studying Effects of Pilot Aging

By Robert H. Cook

Washington—Impact of turbojet aircraft operations on air safety has led the Federal Aviation Agency to establish a new medical research program designed to explore the effect of pilot aging on performance.

Expected to result in more complex and exacting pilot physical examinations, the program's primary objective is the early detection and diagnosis of accelerated aging processes which could affect a pilot's proficiency, especially with the faster, more demanding turbine-powered aircraft.

Present physical standards for pilots are too general, FAA physicians contend, and are based solely on the applicant's chronological age balanced against his past health and only a portion of his over-all physical condition. Too often, pilots have been involved in accidents or have been forced to curtail their careers because of physical deficiencies shortly after passing examinations in which these deficiencies went undiscovered, FAA says.

Noting that its present medical knowledge is insufficient to keep pace with its medical certification needs, FAA expresses particular concern over "the picture of large numbers of older pilots in control of high performance aircraft, with a continually expanding fleet of jet aircraft."

FAA believes the basic solution to this over-all problem lies in gradually changing the present medical examinations, on the basis of continuing research, until a pilot's condition can be determined accurately on the basis of his physical aging rate, rather than his chronological age. On the basis of age studies made in other industries, FAA physicians believe the predominant infirmities affecting a pilot's career are a result of his aging rate and could be predicted well before they become a definite problem.

Once its research produces enough data to justify changes in the present physical standards, FAA points out, it will be able to warn pilots of any susceptibility to aging diseases.

Conversely, the agency anticipates that an increased knowledge of these diseases also will result in many pilots passing their physicals who would be disqualified under presently more general rules.

To achieve these goals, FAA has established a Clinical Research Division located at Georgetown University Hospital, where the agency can make use of the hospital's laboratory and consulting services.

This location also permits the division to compare its findings on individual pilot aging against hospital patients of the same chronological age.

Research data on which to base changes in the present physical examination is being collected on a daily basis from Washington area pilots and traffic controllers who have volunteered to participate in the program in addition to their semi-annual examinations. Concentrating on physical functions which past research has shown are among the first to be affected by aging, the clinical research examinations are divided into eye, ear, heart, brain, nervous system and lung capacity tests which currently take a full day to complete.

A total of 25 subjects are now involved in the research program, which FAA says will eventually be geared to handle an estimated 60 volunteers a month at the facility.

Comparing Results

Once this volume is reached, the division feels it will be able to compare its findings with results of similar studies on air traffic controllers now being conducted by FAA's Civil Aeronautics Research Institute in Oklahoma City, Okla., and with outside research projects, to arrive at an appropriate statistical curve which can be used to begin changing the present physical examinations.

Initial budget for the new division was set at $415,000, most of which has been spent for new equipment, but it will be increased to $1.3 million in Fiscal 1962 as the project gets into full operation.

Under Dr. John E. Smith, chief of FAA's Research Requirements Division, the Clinical Research Division will concentrate its efforts in these areas:

• **Visual and Auditory**—Use of new equipment, such as retinal cameras, is expected to eliminate much of the "guess work" in eye examinations given by different doctors. Photographs of retina blood vessels will be taken at each examination and continuously compared with past photos as a possible means of detecting changes which could signal the early beginnings of arteriosclerosis.

Ability of the pilot's eyes to adjust to sudden changes of light frequency will be monitored in a similar manner by a pupilograph camera. FAA points out that it is known that the frequency response of the human eye diminishes significantly between the ages of 40 and 45, so that a photographic comparison of a pilot's eyes could give a reasonable indication of how long his vision would permit him to fly.

Hearing tests are conducted in a soundproof room and are planned to include pilot ability to hear clearly against a simulated background of tower instructions and aircraft noise.

• **Cardiovascular**—Heavy emphasis will be placed on experiments in this section in an effort to gain enough knowledge of the circulatory system to permit FAA doctors to predict changes in heart function. Most of this study area will concentrate on the use of ballisto cardiograph studies to measure the amount of thrust caused by contraction of the heart .

FAA feels it can gain more accurate knowledge of the heart function and its effect on the brain through the ballisto technique. Evidence to date indicates that a strong heart thrust aids blood circulation, while a weaker thrust has a bearing upon patient's brain wave readings.

Electrocardiograph readings, which measure the sequence of heart beats, are a part of the present physical examinations, but will be expanded under the research program to include several separate areas of the heart. Continuous blood pressure readings will also be given the subject, and FAA hopes to eventually duplicate experiments at its Oklahoma City research center where medical data on air traffic controllers is being gathered by equipping controllers with transistorized vests which record their heart beat, blood pressure and other data while they work.

• **Neurological**—Relationship between aging processes in other parts of the body and the brain will be explored by comparing electroencephalograph tests with results from other test areas. Too often, FAA claims, many problems blamed on the brain have actually been the fault of sickness in other areas.

• **Pulmonary**—Evaluation of tests in this section will be done by an analog computer to develop a simple pulmonary function test. Primary purpose will be to determine the oxygen capacity of the subject's lungs and the amount of carbon dioxide retained in the bloodstream. Separate test results will be recorded on magnetic tape for final evaluation by the computer.

• **Behavioral Sciences**—Series of tests designed to determine the subject's ability to coordinate all functions of vision, sound and response will be made by this section in an effort to judge reaction times on a workload pattern similar to that encountered in actual aircraft operations.

Results will be correlated with other clinical findings to determine at what rate responses decrease from youth to middle age.

Examiner Opposes All-Cargo Competition

Washington—Selection of Flying Tiger Line as the sole all-cargo carrier serving transcontinental routes on a non-subsidy basis and of Riddle Airlines as the only all-cargo carrier, with subsidy support, on north-south routes, was recommended last week by Civil Aeronautics Board Examiner Merritt Ruhlen.

In his initial decision in the Domestic Cargo-Mail Service Case, Ruhlen found that "an enormous untapped air freight potential exists" but that the anticipated "breakthrough" into substantial diversions from surface transportation is several years away. He further concluded that the early potential is not sufficiently high to justify competitive all-cargo services and made these recommendations:

• **East-West domestic route** should be granted Flying Tiger, rather than Slick Airways, because of the relatively stronger financial condition of Flying Tiger and the fact that Flying Tiger has shown a steady growth in its traffic volume, while Slick has "remained fairly static." He noted that Slick had suspended its service for more than two years and has no plans for resuming scheduled operations until a decision in the cargo-mail case is reached. He also said that Flying Tiger's proposal for introducing Canadair CL-44 turboprop all-cargo aircraft into service "is more definitive and will occur sooner than the similar proposal of Slick."

• **Riddle was chosen** for the north-south routes over AAXICO because of its record of steady performance and its detailed plans for operation of the service with modern all-cargo aircraft. Riddle has ordered seven Armstrong Whitworth Argosy turboprop freighters. Ruhlen indicated concern over frequent changes in Riddle's management, the fact that it had suffered substantial losses and, at present, has a total equity capitalization of only $350,000. He found AAXICO to have a stable management, capable of showing profits, but added that the carrier discontinued regularly scheduled services 18 months ago and has no firm plans for acquiring modern all-cargo equipment.

• **American Airlines** would be authorized to provide air transportation of property and mail on a number of transcontinental route segments and Delta Air Lines, the only other trunkline applicant in the case, would be authorized to provide all-cargo service between Houston and Dallas.

• **All-cargo southern transcontinental** route is not required by public convenience and necessity.

• **Direct all-cargo air service** on a flag stop basis for each domestic military base would be authorized. Service would be provided by the scheduled airline serving the certificated point nearest to the base.

Ruhlen found that a substantial volume of air cargo is available if the service can be provided at rates in the 7-16 cents per ton mile range. He said that changes required to provide service at lower rates include larger, faster and more efficient aircraft, mechanized loading and warehousing systems and improved methods of promotion and sales.

He pointed out that the all-cargo Douglas DC-7 has direct operating costs of eight cents per available ton mile. He said that an aircraft with direct operating costs of less than four cents per available ton mile and indirect costs in the 2-4 cents range would provide total break-even costs, at a 70% load factor, of 8.6 to 11.4 cents per ton mile. Both Slick and Flying Tiger claimed during hearings that the Canadair CL-44D, the Douglas DC-8A, the Lockheed Super Hercules and the Boeing 735 could be operated with direct operating costs close to four cents a ton mile.

Airfreight Potential

Analyzing the airfreight potential on the transcontinental routes, he found that American, Flying Tiger, TWA and United flew 239 million ton miles of scheduled air freight in 1959. Assuming an average annual increase of 20%, this would mean a total of 422 million tons of air freight will be carried by these airlines in 1961, he said. Ruhlen concluded that if all this traffic were carried on the all-cargo aircraft operated by these carriers, the average load factor would be only 79.3%, which would be substantially less if a large portion were diverted to passenger aircraft.

He added that it is possible that transportation of cargo in all-cargo aircraft is "still uneconomical and that a self-sufficient operation is not feasible." But, he said, it appears that "there is sufficient air cargo potential to justify continuing experiments with this type of service."

On this basis, the examiner found that all-cargo carriers which do not provide passenger services to support their operations, should be given maximum flexibility in developing cargo service.

He said that many points on cargo routes either generate insufficient traffic to support direct air service or are so near other scheduled points that additional stops would cause such delays in service that the speed value of air cargo would be lost to the shipper. He then added:

"Under such circumstances, the all-cargo operator should be permitted to serve such cities by truck-air service to the nearest regularly scheduled airport until sufficient traffic is developed to support direct air service. Likewise, the all-cargo carrier should be permitted to provide demand service to all points on its route generating insufficient regular traffic to support scheduled service."

The report recommended that since Flying Tiger did not request subsidy unless subsidy is granted to a competing all-cargo carrier, that its certificate should be limited to the transportation of property and non-subsidy air mail.

Ruhlen said it was "impossible" to determine the amount of subsidy Riddle Airlines will require and the length of time it will need such subsidy. He estimated that the maximum necessary may reach $2 million annually, which he termed "reasonable when compared with the subsidy of local service carriers" and added that economic self-sufficiency should be attainable by all-cargo carriers within a reasonable time.

Soviets Conceal Data On Aeroflot Traffic

Moscow—Russia's Central Statistical Administration has taken special pains to conceal significant data on Aeroflot's 1960 traffic, listing only vague, percentage gains for Soviet air transportation in its year-end report, while providing unit statistics on production of industrial and agricultural products and consumer goods and giving specific ton-kilometer figures for railroad, river, highway and pipeline transportation.

The report said that total air transportation (passengers, cargo and mail combined) increased 30% in 1960, compared with 1959, and that the USSR's over-all goal for air transport was fulfilled by 101%. No breakdown was given to show the nationwide increase in air passengers, cargo and mail as separate categories.

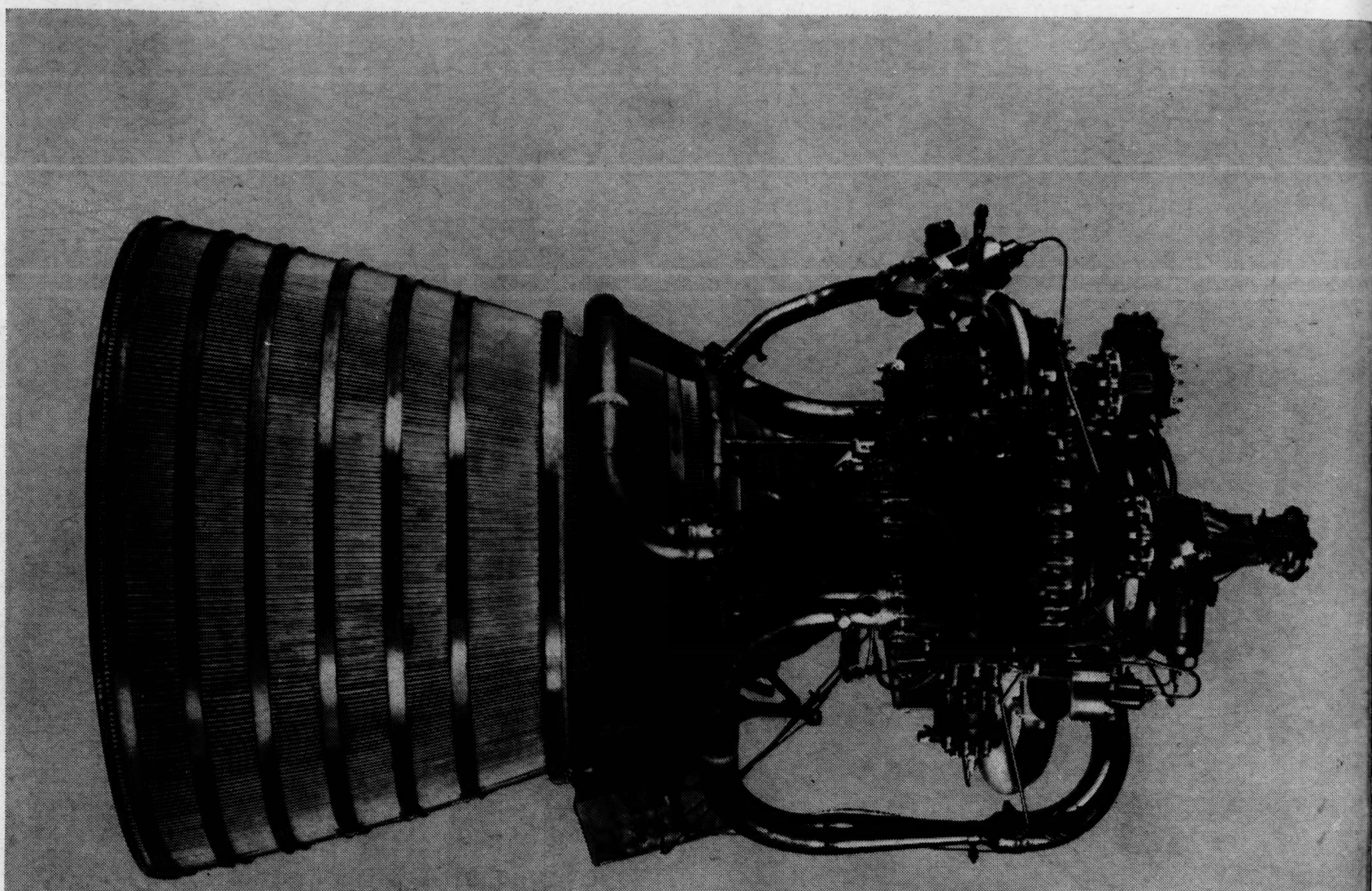
However, a less-publicized report, covering the Russian Soviet Federated Socialist Republic alone, stated that the number of air passengers increased 28%, cargo tonnage 19%, and mail tonnage 51%. It admitted that Aeroflot's mail volume fell below the planned level.

Figures for the Central Statistical Administration, while covering only one of Russia's 15 Union Republics, are indicative of Aeroflot's over-all domestic operations. The administration includes 76% of the USSR's territory and most of the nation's major traffic hubs such as Moscow, Leningrad and all Siberian points.

Soviet airport transportation equipment includes self-propelled automatic transporter (above), used together with electric car train (partially visible at left) to transport cargo to and from aircraft. Each car of the train has an 1,100-lb. capacity; train travels at 5.6 mph.

Soviets Display Cargo Transport, Loading Equipment

Automatic hoisting vehicle at left, designated "APK-6 x 4.5" is used for loading cargo aboard Tu-104 turbojet transports. Vehicle can raise a 10-ton load 150 ft. above the ground. AL-1 automatic lift (right) has load capacity of about 1½ tons, is used for loading supplies.



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Off-Season Atlantic Passengers Up 35%

By Glenn Garrison

New York—Transatlantic scheduled airlines, fighting to keep pace with vastly expanded seat capacities, increased their passenger traffic by 35% during the last three months of 1960 over the same period of the previous year.

Capacity rose 53% for the quarter, however, and over-all passenger load factor dipped from 62% to 56%. The final months of 1960 marked the first off-season period in which most transatlantic carriers were operating their new jet fleets on a large scale.

Passenger total for the 1960 period was 384,000, and capacity totaled 681,000 seats.

For the entire year of 1960, the International Air Transport Assn. airlines carried 1,745,000 scheduled passengers on the North Atlantic, a healthy 30% increase over 1959. Capacity was up 31% for the year to 2,718,000 seats. Load factor for the year in both directions was 64%.

With 170,000 charter passengers also carried by the scheduled lines, North Atlantic traffic totaled 1,915,000 passengers for the year. Carriers early in the year had predicted a total approaching the two-million mark (AW June 27, p. 43), but the rate of increase for the first nine months was somewhat below predictions (AW Nov. 7, p. 40) and the final quarter results didn't quite make up the difference.

Jet Impact

The year was the first in which widespread impact of jets was felt. Only three North Atlantic IATA carriers were flying jets on the route at the end of 1959; by the end of 1960, only three were not. Many of the operators were offering 100% jet schedules.

Despite the big increase in capacity, the number of scheduled passenger flights declined because of the greatly enlarged carrying capacity of each jet over piston aircraft. In 1959, the total of flights was 28,144; last year, the total was 26,641.

The off-season, 17-day excursion fare, which went into effect last October, was cited by most carriers as a major reason for the strong showing during the final months of last year. Attraction of the jets themselves, and some further success in selling the idea of off-season travel, were also noted.

The excursion fare is up for review this year. Its critics feel that the 17-day limit is too short, and should be extended.

The 170,000-passenger charter total represents a slight drop from the 1959 figure for the IATA North Atlantic carriers. That total was 173,000. But military charter passengers were counted in the 1959 total and were not counted in the 1960 figure.

Here are individual 1960 results of the six leading North Atlantic carriers in terms of passengers carried:

• **Pan American World Airways** carried 341,000 passengers, up from 308,000 in 1959. At year-end, 86% of PanAm's North Atlantic flights were in jet equipment. This compares with 67% jet flights at the end of 1959. The airline's jet fleet has grown during that time from six Boeing 707-120s and 21 707-320s to six 120s, 23 320s, and 18 Douglas DC-8s. Total capacity for the year was 493,779 seats, up from 381,417. The airline's load factor, apparently as a result of the influx of jet competition, dropped from a booming 81% in 1959 to 69% in 1960.

• **British Overseas Airways Corp.** carried 254,000 passengers on the North Atlantic during 1960, up from 211,000 the previous year. During 1960, BOAC withdrew de Havilland Comet 4 jets from the route and substituted Boeing 707-420 equipment. The airline also operates Bristol Britannia turboprops on the North Atlantic. During the last three months of 1960, BOAC carried 12,298 jet passengers on the run, up from 4,443 jet passengers during the same period of 1959.

• **Trans World Airlines** increased its passenger total by 67% to 243,000 passengers. Capacity rose 71% to 386,000 seats. TWA's first transatlantic jet service was inaugurated late in 1959, so last year was its first full-scale jet operation on the route. At the end of 1959, two Boeing 707-320s were in service; there were eight at the end of last year. Weekly jet seats available in each direction rose from 780 to 2,970, an increase of 261%. About 86% of TWA's 1960 transatlantic passengers were carried in jets.

• **Air France** carried 127,000 passengers, up from 98,000 in 1959. Capacity was up from 151,000 seats to 186,000 seats. Air France, flying 707-320s, was 100% jet by last April on services between North America and Europe. In October and November, the carrier's eastbound passenger traffic was up 108.5% and the westbound passenger total was up 65.4%.

• **Scandinavian Airlines System,** with DC-8s, was 100% jet on the North Atlantic at year-end. Passenger total for 1960 was 122,000 passengers, up from 103,000 in 1959. Last year's capacity total was 202,000 seats, up from 161,000. During the final quarter of 1960, SAS's passenger total was 22,000, up from 18,000 during the same period of 1959, and capacity was up from 31,000 seats to 46,000 seats.

• **KLM Royal Dutch Airlines** carried 116,000 transatlantic passengers, excluding the carrier's traffic from Montreal. Last year's comparable total was 93,000 passengers. Capacity for 1960 was 184,000 seats (including Montreal), up from 144,000 seats. At year-end, KLM's fleet was 75% jet with DC-8s. The Dutch carrier believes the 17-day fare has been more successful in bringing tourists to the U.S. than from the U.S. to Europe. Reason: Americans can save money, KLM says, by spending a longer time in Europe than 17 days even with the fare differential.

Among the other individual operators, Lufthansa German Airlines carried 97,986 passengers during the year, an increase of 48%. Capacity increased 37% to 138,675 seats. Lufthansa was all-jet at year-end, operating 707-320s. During October and November, the German carrier offered 26,000 seats and carried 16,120 passengers, up from 15,000 seats and 8,722 passengers.

Sabena Belgian World Airlines, operating all-jet with 707-320s since last April, experienced a 38% increase in passengers carried over the 54,000 total for 1959. Capacity was 21%. Sabena was out of transatlantic operation temporarily during part of last year because of the Belgian Congo disturbances.

Alitalia, 100% jet at year's end with DC-8s, carried 61,692 passengers during 1960, a 55% increase. Capacity increased 43% to 93,000 seats.

Another all-jet operator at year-end was Swissair, flying DC-8s. El Al Israel inaugurated its first jet schedule on the Atlantic last month with 707-420 equipment. El Al recently ordered a third 707-420 (AW Feb. 13, p. 41).

Jet Replacements

Irish International Airlines, which inaugurated Boeing 720 service on the North Atlantic in December, has replaced leased Lockheed 1049H Constellations entirely with the jet equipment. Qantas Empire Airways is all-jet with 707-120s.

Air-India started transatlantic service for the first time last May with 707-420s and has been all-jet on the run since then. Trans-Canada Airlines began DC-8 service last summer and now uses only that equipment on the Atlantic.

Canadian Pacific Airlines, now flying Britannias over the North Atlantic, has not received its first DC-8s as yet and plans for transatlantic jet service are not definite. Iberia Airlines of Spain has ordered DC-8s and expects to begin jet service this year.

News of Local Service Airlines

Texaco offers this series of informative bulletins in recognition of the vital new dimension being added to business activity by local service airlines. Texaco Inc., Aviation Sales Department, 135 East 42nd St., New York 17, N. Y.

Special local transport airline flights make unusual contract obligations possible. Thanks to **flexible** local transport airline facilities, business men now often find it possible to fulfill contract obligations in a manner unheard of a generation ago.

Take the huge Ballistic Missile Early Warning System that RCA is building for the Defense Department. Since the project is near Fairbanks, Alaska, close communications with company headquarters posed a problem.

The solution was found when RCA contracted **Alaska Airlines** to operate a once-weekly round-trip flight service between Philadelphia and Fairbanks. Flights involve 6,866 round-trip miles per week . . . a total of over 300,000 miles for the year. Cargo includes both men and materials.

Air freight expands to include direct ground link. Local service airlines make it possible to fly freight into practically any city in the U.S. Last year, local carriers moved over 5 million tons of air freight—a 200% increase over 1950.

Now, shippers in the Arkansas-Louisiana-Texas area can take advantage of a new convenience offered by **Trans-Texas Airways.** On May 1, the Railway Express Agency began door-to-door pickup and delivery for Trans-Texas—a direct ground link for their air freight traffic.

Local carrier "watch dog" service protects nation's timber stands. Stranded vessels have been saved. Strayed livestock recovered. Fishermen rescued. Power line breaks discovered. All because of the vigilance of local carrier flight crews. But perhaps the most valuable "watch dog" service these men perform is detecting and reporting forest fires.

Pacific Air Lines flights, for instance, cover 26 national forests as well as many of the nation's most valuable stands of timber. Last year, Pacific flight crews alerted state and national forest firemen to fires in many areas—thus helping prevent the loss of millions of dollars worth of standing timber.

Roster of local service airlines

Alaska
Alaska Coastal
Allegheny
Aloha
Bonanza
Caribair
Central
Cordova
Ellis
Frontier
Lake Central
Mohawk
North Central
Northern Consolidated
Ozark
Pacific
Piedmont
Reeve Aleutian
Southern
Trans-Texas
West Coast
Wien Alaska

Local carriers offer exciting vacation tips for the time- and budget-conscious. Because they cover the entire United States, local service airlines offer almost unlimited vacation possibilities. Skiing, skin-diving, sightseeing, bull-fight attending—to name just a few. Vacation planners find local carrier facilities especially helpful in planning short or inexpensive vacations. **Bonanza Airlines** flies vacationers to all the scenic wonders and famous winter resorts of the Southwest—including fabulous Las Vegas. **Trans-Texas Airlines** schedules week-end flights at special rates to the colorful old cities of Laredo and Nuevo Laredo. Or, for something different, travelers can get a breathtaking view of the Hawaiian Islands from **Aloha Airlines** sightseeing planes. Special lens windows let shutterbugs take undistorted shots of nature's grandeur below.

Central Airlines offers perhaps the **shortest** vacation on record. As part of its regular service, it schedules 20-minute, Sunday afternoon "Scenic Flights" over the 36 cities in its area. The cost? Just $2.50.

Airline Traffic—December, 1960

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor (%)
DOMESTIC TRUNK								
American	579,515	466,387	60.3	3,207,169	1,055,388	9,900,144	58,880,489	54.9
Braniff	171,199	82,965	55.1	522,050	185,866	805,436	9,457,258	45.4
Capital	252,233	107,123	51.7	583,475	299,997	505,902	11,647,151	48.3
Continental	105,432	70,551	47.3	288,340	126,843	534,703	7,709,417	39.3
Delta	278,891	160,100	58.4	833,472	342,232	1,342,832	17,898,117	50.2
Eastern	590,359	335,408	50.33	1,901,910	617,898	2,235,890	37,096,121	40.76
National	138,121	87,855	51.1	542,156	77,077	863,041	9,985,025	41.7
Northeast	103,884	42,848	47.3	180,447	52,289	261,540	4,593,286	42.2
Northwest	126,440	87,137	52.4	804,845	260,435	1,433,205	10,828,813	51.4
Trans World	361,529	325,490	57.9	2,247,759	851,314	4,765,732	39,052,614	49.1
United	608,841	443,608	59.2	4,689,838	1,038,246	7,357,673	55,561,628	52.6
Western	122,298	73,713	55.8	458,264	110,430	373,067	7,987,016	52.9
INTERNATIONAL								
American	8,507	7,072	42.0	14,432	1,201	318,412	1,064,142	43.2
Braniff	7,333	12,346	50.9	51,144	.....	151,566	1,510,939	46.7
Caribbean Atlantic	31,251	2,214	60.4	4,232	.....	8,729	220,341	60.6
Delta	1,742	2,429	40.3	1,868	.....	15,530	284,718	39.4
Eastern	45,252	69,107	55.26	219,561	.....	507,083	7,174,540	54.90
Mackey	9,666	2,062	49.8	.....	322	6,713	208,800	48.9
National	2,534	2,166	55.4	1.372	.....	3,572	242,564	53.4
Northwest	10,320	14,800	46.6	1,989,662	9,247	657,443	4,368,901	67.6
Pan American-Alaska	4,807	5,505	50.4	68,647	3,761	156,662	802,696	52.7
Atlantic	106,919	139,567	50.9	3,611,303	.....	4,799,254	23,290,349	50.6
Latin America	93,776	111,769	59.6	677,425	.....	4,541,427	16,507,688	58.6
Pacific	36,895	133,896	59.2	5,099,953	19,001	3,351,924	22,450,921	58.1
Panagra	11,051	19,213	60.5	120,362	.....	658,444	2,879,168	59.6
Resort	.....	.....	.....	.....	.....	1,973,671	1,973,671	79.4
Trans Caribbean[1]	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	24,857	77,234	52.2	2,518,185	.....	1,574,987	12,401,185	55.8
United	10,107	25,211	53.5	426,693	10,805	131,079	3,127,126	59.5
Western	4,111	6,392	60.8	13,598	.....	18,754	697,506	63.1
LOCAL SERVICE								
Allegheny	50,147	10,261	34.2	28,954	37,005	59,379	1,104,146	37.5
Bonanza	20,032	5,036	37.1	12,764	4,027	9,259	509,483	38.5
Central	12,627	2,549	36.5	14,653	4,308	11,159	247,147	34.1
Frontier	27,637	7,461	38.4	47,118	10,413	60,662	836,487	43.4
Lake Central	14,977	2,358	32.5	6,728	15,520	.....	247,772	36.1
Mohawk	47,052	9,774	39.6	24,944	20,996	21,180	988,889	37.3
North Central	75,623	13,675	38.99	63,175	47,704	64,922	1,502,309	41.21
Ozark	41,845	7,667	39.3	27,345	25,279	30,163	816,083	43.8
Pacific	33,948	8,029	46.8	20,409	4,643	9,321	799,760	41.4
Piedmont	31,861	6,994	40.3	24,410	15,486	25,431	735,564	43.0
Southern	26,967	4,969	26.8	26,756	13,136	17,153	533,719	28.7
Trans-Texas	23,326	5,425	36.3	30,813	13,436	41,964	605,305	38.8
West Coast	25,574	6,483	40.30	21,308	5,205	18,768	664,457	41.30
HAWAIIAN LINE								
Aloha	27,002	3,843	57.1	5,837	.....	9,013	322,960	47.3
Hawaiian	39,362	11,220	68.2	8,510	.....	174,214	1,124,336	61.4
CARGO LINES								
AAXICO[2]	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	.....	.....	.....	.....	.....	375,953	375,953	63.83
Flying Tiger	4,812	25,494	67.8	29,185	36,001	8,629,302	11,243,930	74.2
Riddle—Domestic[1]	.....	.....	.....	.....	.....	.....	.....	.....
Overseas[1]	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western	1,500	4,476	100.0	1,677,189	.....	1,827,342	4,162,342	64.3
Slick	1,090	7,458	100.0	.....	.....	472,081	1,217,862	100.0
HELICOPTER LINES								
Chicago Helicopter	19,593	326	34.1	1,058	.....	.....	32,165	28.6
Los Angeles Airways	2,654	95	46.2	5,869	2,727	.....	17,650	59.9
New York Airways	10,297	232	49.2	1,701	589	568	24,997	48.1
ALASKA LINES								
Alaska Airlines	8,503	8,675	54.3	111,919	2,039	366,867	1,335,554	65.2
Alaska Coastal	3,357	359	53.5	6,244	.....	6,781	49,550	65.5
Cordova	796	136	36.1	6,512	.....	44,770	65,867	54.9
Ellis	3,534	207	47.8	3,134	.....	2,594	26,759	61.9
Kodiak Airways[3]	537	23	39.04	430	.....	470	3,129	37.60
Northern Consolidated	1,464	485	29.7	56,797	.....	54,824	165,361	56.8
Pacific Northern	9,520	9,602	47.2	262,604	12,526	398,387	1,716,112	68.7
Reeve Aleutian	897	950	34.3	78,254	.....	61,162	244,784	56.3
Western Alaska	290	15	56.0	931	.....	352	2,706	57.0
Wien Alaska	2,041	414	22.6	55,492	.....	52,550	150,871	44.3
Avalon Air Transport	2,119	163	37.3	601	.....	286	16,403	39.4

[1] Not available. [2] No operations this month. [3] Dec. 4 through 31, 1960.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

HAWKER SIDDELEY AVIATION 32 Duke Street, St. James's, London, S.W.1.

BEA Plans London Passenger Terminal

New York—British European Airways wants to build its own passenger terminal at London Airport. The carrier will ask British Ministry of Aviation permission to construct the terminal on airport property.

BEA chief executive Anthony H. Milward, here during a tour of U.S. airline, manufacturing and airport facilities, expressed dissatisfaction with British airport operation and said U.S. planning of airports is considerably superior.

American airports such as Los Angeles and Idlewild are planning far ahead, and spending vast sums of money on future airport needs, while "we keep on patching and adding bits here and there," he said.

Ministry operation of British airports results in a lack of commercial thinking, Milward said, and an airport authority approach to the operation probably would be better. One criticism the BEA executive made of London Airport was its high landing fees, "the highest in the world," he added. With a proposed increase of about a third in the fees, such carriers as Pan American and TWA will be paying twice as much at London as at U.S. airports, Milward said.

Of the U.S. airports, Milward said he probably favors the centralized concept of Los Angeles to the individual terminal arrangement provided at Idlewild.

The British official visited Boeing Airplane Co. facilities during his tour and described the projected Boeing 727 jet transport as a very good airplane, similar in many respects to the de Havilland DH 121 Trident on order by BEA. A layman couldn't tell the difference between the two triple-engine planes, he said, and "there's a good deal of leg-pulling about who copied from whom." Both are scheduled for 1963 delivery, but Milward said that delivery of the Trident should be ahead of the 727.

BEA has been considering Sikorsky S-61 and Vertol 107 helicopters for "stopgap" scheduled helicopter use, along with the twin-rotor Bristol 192C. All these machines are intermediate and will not permit self-supporting operation, Milward believes. Inter-city helicopter service is unlikely to be a reality until a 50-passenger helicopter is in service.

BEA probably will buy the Bristol rather than one of the American helicopters, Milward said. This is not necessarily because of a buy-British requirement of the government. BEA has been a profit-making operation for some time, the chief executive noted, and has encountered little administrative interference from the government. There has never been a test case concerning purchase of foreign-built aircraft, although there would be if the decision favors an American helicopter. In that case, Milward said, he feels BEA would be permitted to buy American if it desired.

London Monorail

London—Two British airline officials last week gave a cautious welcome to the idea of constructing a monorail system between London Airport and a downtown terminal in order to speed ground transportation.

Two systems, one French and one West German, were presented to British Overseas Airways Corp. and British European Airways officials. If the idea is supported by the government, BEA Chairman Lord Douglas of Kirtleside said, BEA would be ready to contribute about $2.8 million to the capital cost. BOAC Deputy Chairman Sir Wilfred Neden said his airline would contribute, but did not specify an amount.

On the basis of earlier tests, the French monorail system is said to be capable of carrying 30,000 passengers an hour each way at 75 mph. Cost would be about $4.48 million per mile.

The German monorail system was said to provide accommodations for 125 passengers in each coach, operate at 50 mph., and cost $2.24 million per mile.

First 707-320B to Be Delivered in March

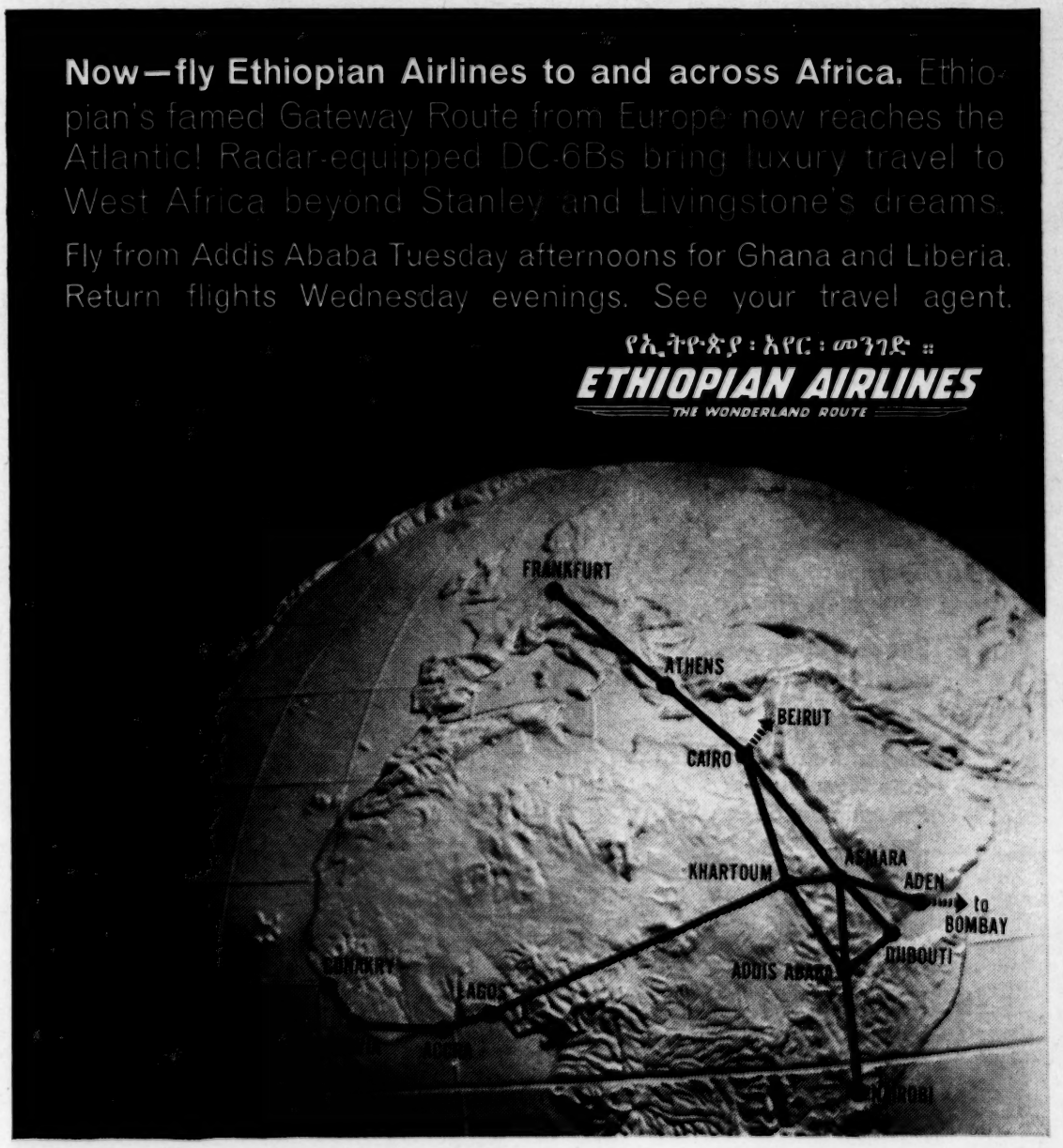
First of Boeing's turbofan-powered 707-320B Intercontinentals, the longest range version of the 707 series, will be delivered in March to Pan American World Airways, which has ordered five of the aircraft. Four Pratt & Whitney JT3D-3 engines (advanced versions of the turbofans now being used in late models of the 707 and 720 aircraft), equipped with water injection, will power the 707-320Bs.

Boeing claims a 15% performance improvement over the standard 707-320 models.

Full-span leading edge flaps and more efficient trailing edge flaps on the 707-320B are designed to improve takeoff and landing performance, without appreciably changing the airplane's empty weight.

Taxi weight of the 707-320B is 317,000 lb., maximum flight weight 312,000 lb., and allowable payload 56,900 lb.

Over-all length of aircraft is 152 ft. 11 in., wing span is 145 ft. 8½ in.



A. First Stage

Honeywell Servo System controls the vehicle by means of jet vanes and aerodynamic surfaces. Signals from the Honeywell Guidance System in the third stage properly actuate high performance servo valves to control the hydraulic servos. A Honeywell Programmer in the third stage controls coast time and ignition of the second stage.

B. Second Stage

While the second stage is operating, attitude is controlled by an 8-nozzle hydrogen peroxide reaction jet system responding to command signals from the Honeywell Reference System and Programmer in the third stage. Other command signals from the same source control ignition of the third stage.

C. Third Stage

Attitude during third stage operation is controlled by a two-level, 10-nozzle hydrogen peroxide reaction jet system. The Honeywell Inertial Reference System and Programmer in this stage also provides a stable launch platform for the spin imparted to the fourth stage before separation, initiates separation of the third stage and ignition of the fourth stage.

D. Fourth Stage

The basic Scout configuration provides for having spin rockets impart a 160 rpm rotation to the fourth stage prior to separation from the third stage and ignition. For other missions, the fourth stage will be guided by its own Honeywell Inertial Reference System.

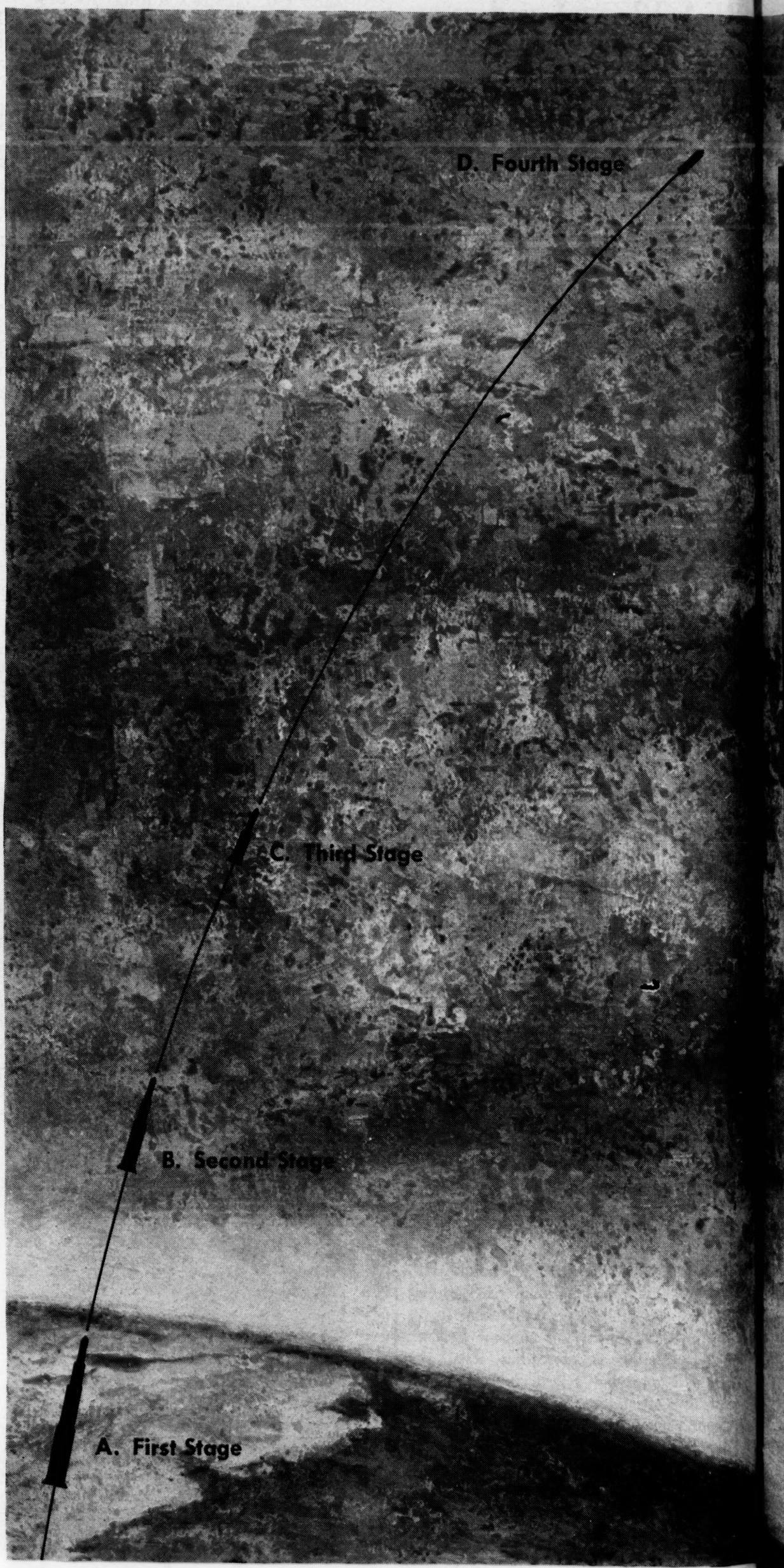
Honeywell Systems and components on Scout

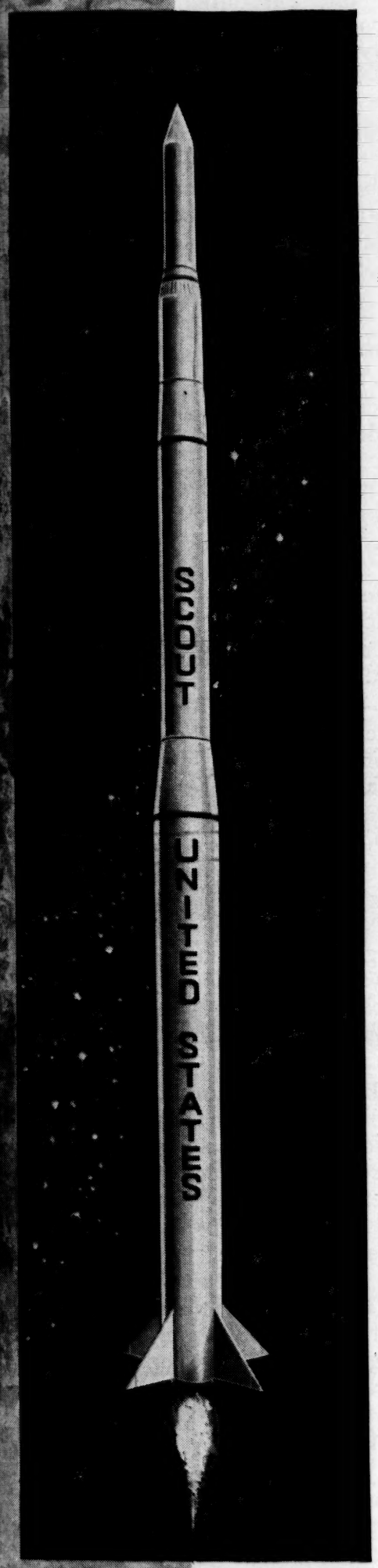
A. First Stage
- *Servo System*
- *Hydraulic Pump*
- *Battery Supply*

B. Second Stage
- *Reaction Jet System*

C. Third Stage
- *Inertial Reference Package*
- *Rate Gyro System*
- *Reaction Jet System*
- *Programmer*
- *Battery Supply*
- *Inverters*
- *Miscellaneous Electronic components*

D. Fourth Stage
- *Inertial Reference Package (on some missions)*





The ABC's of SCOUT

Honeywell provides complete control system integration for unique NASA "workhorse" space vehicle

The NASA Scout gives the U. S. a multi-purpose vehicle featuring simplicity, reliability and economy. The Scout has been fired three times since July 1, 1960, and according to NASA, "guidance and control systems performed satisfactorily on all three flights."

To illustrate the flexibility and, therefore, the control problems involved in this Scout program, consider that this solid fuel propelled vehicle is designed for a variety of space missions, putting payloads into these orbits: 80 lbs. at 600 mile orbit, 100 lbs. at 500 mile orbit, and 150 lbs. at 300 mile orbit.

Honeywell engineers analyzed these problems and created a new lightweight, reliable control system that provides the flexibility required for this wide range of missions.

The system uses three orthogonally-mounted precision miniature integrating gyros providing control of pitch, roll and heading. The gyros receive precise torquing commands from the mission programmer to change the vehicle course to correspond with the desired mission path.

With this method of attitude control, great mission flexibility is obtained through simple changes in resistance and timing networks.

Honeywell's system analysis of the vehicle requirements also dictated the selection of hydraulic actuated jet vane and aerodynamic controls for the first stage. Hydrogen peroxide reaction jet systems were selected by Honeywell systems specialists for second and third stage control.

Honeywell backs Scout's guidance and control system with complete ground support equipment for servicing, checkout and launching.

The Scout guidance system program is only one of many in which Honeywell has proven its "quick reaction" system analysis, design and management abilities. Other programs include Dyna Soar, Mercury, X-15, Agena B, Thor Delta and Discoverer. To learn how Honeywell can help solve your system design and integration problems, contact your nearest Honeywell representative or write Honeywell, Military Products Group, Minneapolis 8, Minnesota. *Sales and service offices in all principal cities of the world.*

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AIRLINE OBSERVER

► Recent strength in airline common stocks is attributed by Wall Street to expected improvement in earnings during the second half of the year. Some financial observers feel there are subtle indications that industry is getting costs under control and that the rising cost trend will soon begin to level off.

► **Watch for hot competition between Seaboard & Western Airlines and Flying Tiger Line to get the first Canadair CL-44 swing-tail freighter into service. Under the latest Canadair delivery schedule, Seaboard will get the first production CL-44 this month, its remaining four by August. First of 10 CL-44s ordered by Flying Tiger is scheduled for delivery in March. Both carriers hope to inaugurate service in July. Slick Airways is scheduled to receive its two CL-44s in September and October, and plans to resume service in November.**

► Initial investigation of American Airlines' Boeing 707-120 crash Jan. 28 off the Long Island shore (AW Feb. 6, p. 36) indicates that the aircraft was engaged in training maneuvers similar to those involved in the crash of a Braniff Airways Boeing 707 near Seattle in Oct., 1959 (AW Oct. 26, 1959, p. 45). Three engine pods have been located in separate areas, indicating that three engines were torn from the aircraft before it crashed in the sea. This would suggest that asymmetric power, possibly for two-engine-out training, was being used.

► **Aeronaves de Mexico, which lost its only turbojet transport—a Douglas DC-8—in a crash last month at New York's Idlewild airport (AW Jan. 30, p. 43), will join an equipment consortium consisting of Compania Mexicana de Aviacion and Guest-Aerovias de Mexico. The group now has three de Havilland Comet 4 turbojet transports and will receive a fourth in May.**

► Legislation that would outlaw airline strikes by amending the Railway Labor Act to require compulsory arbitration of work stoppages in the commercial airline industry has been introduced by Sen. Spessard Holland (D.-Fla.).

► **Trans World Airlines will place 14 Lockheed 1649 Constellations—the last passenger-carrying planes of this model in its fleet—on the used aircraft market. Now operating six freighter versions of the 1649, TWA is converting another six 1649s to cargo configuration and will begin operating these aircraft this spring. Balance of the 1649s will be phased out as soon as the airline finds buyers.**

► Federal Aviation Agency has set a June 30 target date for executing Operation Straight Line, an internal reorganization that decentralizes responsibility for procedural changes in the air traffic control system. Under Straight Line, major terminals will be grouped in geographic units under one area chief, who will be able to revise traffic flow patterns without permission from the FAA regional office.

► **Japan Air Lines will buy two additional Convair 880 turbojet transports, bringing its total order to five. The carrier will use the equipment on its southeast Asia route, which now extends to Bangkok, to make that operation all jet by August.**

► Federal Aviation Agency has proposed a rule that would require air carriers to submit daily mechanical reports of aircraft, powerplant or propeller failures and malfunctions.

► **India is not satisfied with performance of the Russian Mi-4 helicopter and has held up the helicopter portion of an order, which also included Soviet An-12 turboprop transports, due to begin arriving in India next month. The Mi-4, under evaluation, developed severe vibration in high blower operation during a proving flight. When shifting to low blower didn't help, the helicopter made an emergency landing and subsequently has spent much time sitting on the ground.**

► Russia's Aeroflot has introduced fare cuts averaging 10-15% on many of its most important trunk routes to stimulate traffic during the late winter and spring.

SHORTLINES

► **Braniff Airways** has received its first Boeing 720-027 medium-range turbojet transport. The carrier has a $15.5-million order for three of the aircraft, and an option on a fourth. The Braniff version of the 720 carries 106 passengers.

► **British Overseas Airways Corp.** reports it carried 47,339 passengers during November, 1960, and flew 147,575,000 passenger miles with a load factor of 51.9%. British European Airways carried 214,513 passengers over its routes last November and flew 69,721,000 passenger miles at a 56.5% load factor.

► **Federal Aviation Agency** has awarded All American Engineering Co. a $61,000 contract for design, installation and testing of a new safety tailhook on a Boeing KC-135 turbojet aircraft as the second phase of an 18-month FAA program to devise ways of eliminating airline transport accidents due to aborted takeoffs and overshot landings. First phase of the program was completed last year.

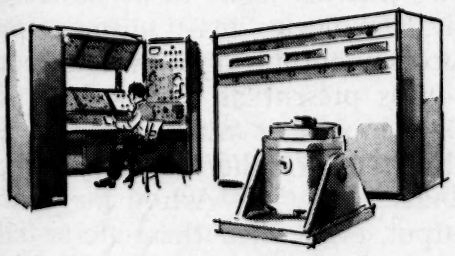
► **International Civil Aviation Organization** has accepted the Republic of Cyprus as its 84th member.

► **New York Airways** reports its Boeing Vertol Model 44 helicopters departed within five minutes of scheduled time on 98.8% of their scheduled flights during 1960, excluding flights canceled for weather conditions. The carrier's Vertol 44 aircraft operated over 40,000 scheduled flights last year.

► **Seaboard & Western Airlines** has received Civil Aeronautics Board exemption authority to operate through-flights from New York to Paris and Chateauroux, France, and Frankfurt, West Germany until Jan. 31, 1962. The all-cargo carrier is authorized to carry regularly scheduled cargo from New York to Paris, military cargo moving at regular tariff rates in common carriage from New York to Paris, Chateauroux and Frankfurt, and U.S. mail from New York to Paris and Frankfurt.

► **Trans-Canada Air Lines** expects to furlough 104 pilots and flight engineers during 1961 as a result of the integration of turbojet transports into its fleet. The airline said that Aer Lingus of Ireland has hired 14 of these TCA crew members and that British European Airways is interviewing to fill 50 positions and expects to have openings for at least 100 by next winter.

Now there are four MB seminars in vibration testing practice



TWO YEARS ago MB initiated the first industrial seminar in the vibration test field—a course in Complex Vibration Practice aimed at engineers and scientists directing environmental testing laboratories.

Initial reaction and subsequent results of this valuable training course were so successful, MB soon afterwards announced an additional series for lab technicians emphasizing practical application of test equipment.

Since then two other seminars have been added to the "curriculum"—one on Fundamentals of Applied Vibration, another on Vibration Fixture Design. With these four seminars, MB makes it easier for environmental test engineers and their technical personnel to properly utilize the various vibration test systems used today.

The enlargement of these seminars in vibration testing practice is but another aspect of MB's continuing efforts to anticipate the ever-expanding, complex needs of the environmental engineer. If you would like information on any of these courses, write to MB Electronics, Technical Services Dept.

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MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC. 1078 State Street, New Haven 11, Conn.

Self-Learning Machines to Use Artrons

By Philip J. Klass

Alexandria, Va.—An artificial neuron called Artron, which can be used to build machines that learn by experience, has been developed here by Melpar. The company will investigate the device's characteristics and its applications to self-learning machines under two contracts recently awarded by USAF's Wright Air Development Division.

Unlike previous artificial neurons, Melpar's Artron is moderately complex in its functioning. Even a single Artron can learn to solve problems such as predicting a cyclic binary series, and a small network of such devices can perform moderately complex problems, according to Robert J. Lee who conceived the Artron.

Lee predicts that a self-learning machine built from Artron will be considerably more versatile than present machines, such as the Cornell Aeronautical Laboratory Perceptron (AW July 4, p. 72).

For example, if the Mark I Perceptron is to be able to learn to identify alpha-numeric characters, they must be correctly oriented and approximately centered in field of view. An Artron machine is expected to be able to learn to recognize characters regardless of their size, orientation or location in the field of view, according to Lee.

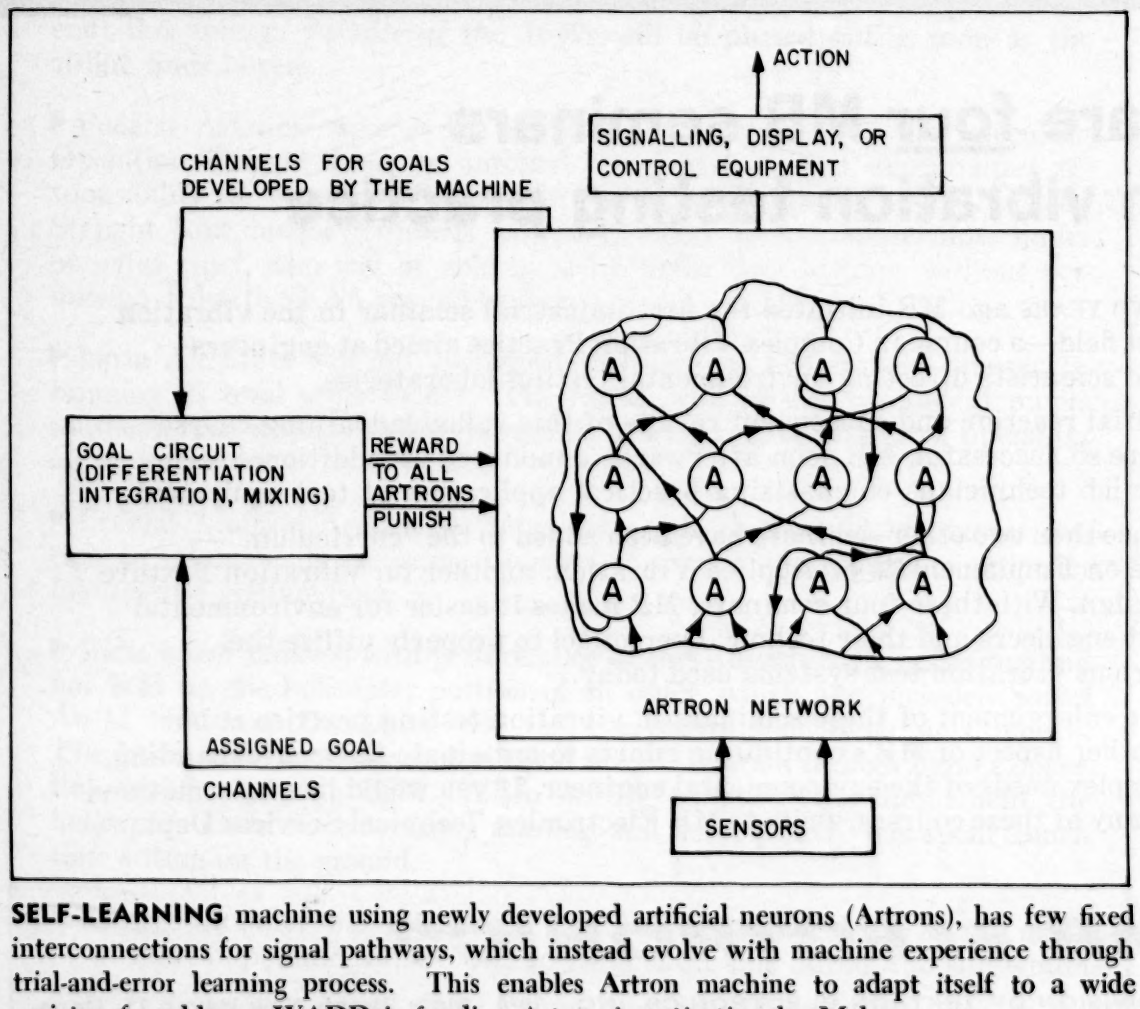
The Artron machine, like the Perceptron, will learn by means of a system of "reward" and "punishment." This consists of signals fed back to the machine during the learning process, either automatically or from a human instructor, to tell the machine whether or not it has made a correct decision.

One of the important differences between the Artron and Perceptron machines is to be found in the electrical connections between the input sensors and the elements which perform the neuron function. For the Perceptron, these electrical connections are made in a completely random manner, but once made they remain fixed until a human operator rewires the machine.

In Melpar's approach, the signal pathways between sensors and Artrons, and between individual Artrons in a complex network, are fluid and changing continuously in a random manner until optimum pathways are evolved as a result of the learning process. Even after the machine has been taught, it can readily return to its original randomly changing signal pathways when subjected to a new problem.

Lee has been working in the field of self-learning machine concepts for nearly a decade, originally as a hobby and since 1958 under Melpar funding. He expresses the aforementioned difference between the Artron and Perceptron machines this way: "Operation of each Artron will be functionally statistical, with memory stored as a probability of behavior, in contrast to the operation of neuron-like units in other well-known learning machines which are functionally determinate but statistically connected.

"The Artron statistics will proceed from random to determinate during the learning process," Lee says. "This can result in machines which are able to solve a vast number of qualitatively diverse problems for which no specific preparation or programing has been provided."



SELF-LEARNING machine using newly developed artificial neurons (Artrons), has few fixed interconnections for signal pathways, which instead evolve with machine experience through trial-and-error learning process. This enables Artron machine to adapt itself to a wide variety of problems. WADD is funding Artron investigation by Melpar.

Artron Principle

In the Artron machine, the reward signal will act to build up chains, junctures and feedbacks within the network to achieve the desired goal or objective, while the punishment signal acts to break up or discard configurations of signal pathways that conflict with the desired goal.

The Melpar Artron is a digital element which has two basic logic inputs and a single output, in addition to the reward/punishment inputs. The incoming signals on either logic input, or both, can come from external sensors or from other Artrons in the network (see sketch). The input and output signals are in digital (pulse) format.

Depending upon the status of the Artron's internal logic, to be described shortly, the device may, or may not, produce an output signal when there are signals present at one or both of its logic inputs or when there is no signal present at either input. Another possibility is that the Artron may have no output, even when there are signals present at its inputs.

Inside each Artron there are four logic gates which determine whether it will or will not produce an output when there are signals present, or absent, from its logic inputs. The four include one AND gate, which generates a signal when there are signals present on both Artron inputs; a NOR gate which generates a signal when there is no signal present on either Artron input; and two "inhibit" gates. One of these will generate a signal if there is a signal present on one Artron logic input but not on the other, while

the second inhibit gate will have an output if the reverse situation exists.

Under every possible combination of signals present/absent at the two logic inputs to the Artron there will be one, but only one, of the logic gates which will be producing a signal. But this does not mean that the Artron itself will have an output under every possible combination, because the output from each logic gate must first pass through a high-speed switching device, or relay, before its signal becomes the Artron's output.

These four high-speed switches, which Lee calls "statistical switches," provide the basic mechanism by which the machine learns and automatically adjusts its internal signal pathways.

The decision to close any one of the four statistical switches within an Artron, or to leave it open and thereby prevent a signal from the logic gate, if present at that instant, from passing through the switch to become an Artron output, is made at periodic intervals. The decision is made by comparing the instantaneous amplitude of a signal from a random noise generator with a predetermined threshold level value.

If the amplitude of the random noise generator output exceeds the threshold, the statistical switch is caused to close; if the amplitude is lower than the threshold value, the switch remains open. The decision to close, or leave open, is made independently for each of the four statistical switches, with each having its own threshold value for closure.

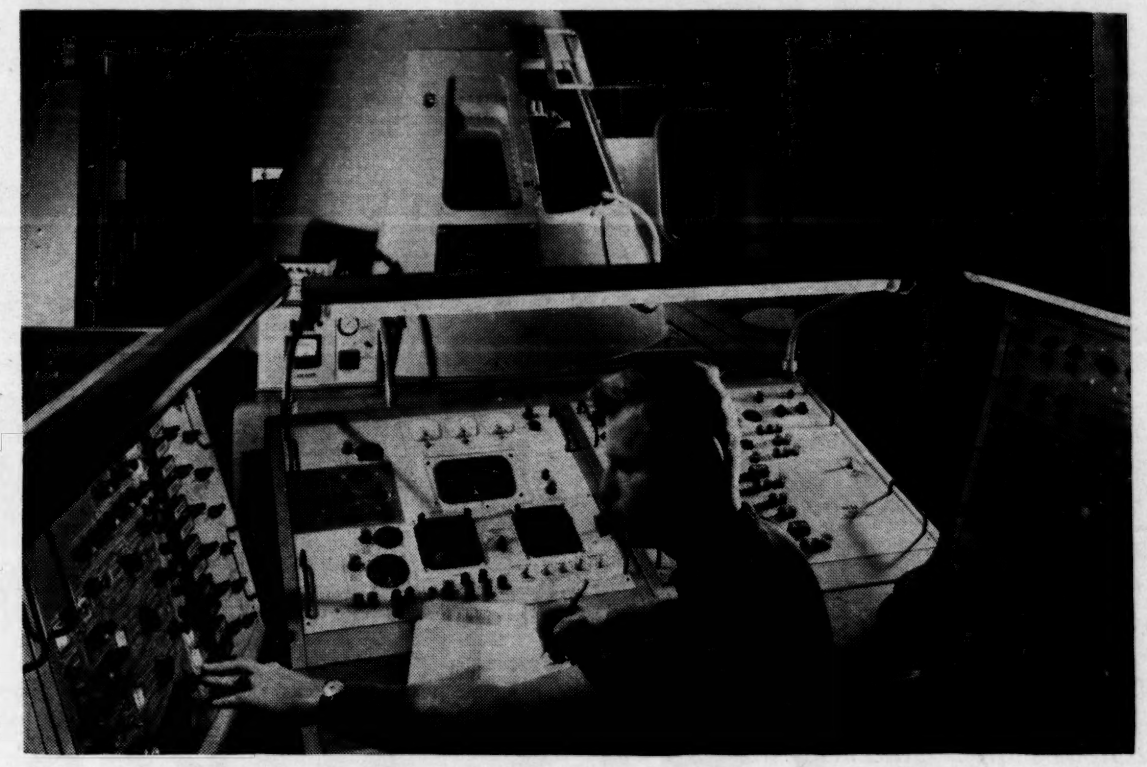
If it were not for the reward/punishment signals fed back to each Artron, which automatically change the switch closure threshold value, the question of whether an Artron produced an output signal for any particular combination of inputs would be entirely a random and unpredictable matter.

When an Artron machine makes a decision, the reward or punishment signal fed back to each Artron changes the threshold value of a statistical switch only if its logic gate is generating a signal at that instant; otherwise, the threshold is unchanged by reward or punishment signals.

If the machine has made a correct decision and if the statistical switch of the signal-producing logic gate is closed, the reward signal reduces the threshold level value. If the switch is open, the reward signal raises the threshold value. The net effect is to condition the Artron so that it will be even more inclined to react in the same manner the next time it receives the same logic input signals.

However, if the Artron makes an incorrect decision by producing an output when it should not (or vice versa), then the punishment feedback signal reverses the procedure described above. If the switch is closed, the punishment signal raises the threshold to make it more difficult for the switch to close the next time the same input conditions prevail. If the switch was open, the threshold is lowered so that it will be more inclined to close the next time under the same input stimuli.

The time increment between periodic trials of this sort, which represents machine learning procedure, may be in the millisecond range or as long as several seconds. The time interval between trials depends upon the nature of the problem and the time needed to obtain a measure of the effect of the machine's latest decision.



Mercury Cockpit Simulator Installed

Project Mercury manned satellite trainer has been installed at the Space Task Group, Langley Field, Va., with a link to a computer for animated displays to provide training in cockpit procedures. The simulator, built by the Mercury prime contractor, McDonnell Aircraft Corp., is one of a number of training devices being used to prepare the seven Mercury pilots for ballistic and orbital flight (AW Aug. 17, 1959, p. 56).

Artron Network

A machine capable of performing moderately complex learning tasks is expected to consist of several dozen Artrons. This Artron network can be a completely random one or can be layed out with a more systematic connection scheme. The former requires a larger number of trials in the learning process before the required signal pathways are established, but makes the machine suitable for a wider range of problems.

In the Artron network, some of the devices will obtain one or both of their logic inputs from machine sensors. Others will receive one or both inputs from other Artrons in the network. Units which receive both logic inputs from other Artrons serve as juncture devices to determine which chain of a network must be applied under a particular set of circumstances.

As the machine gains information about the problem from reward/punishment feedback signals through a trial and error process, the completely random signal pathways in the network begin to disappear and a more stable organization of pathways emerges.

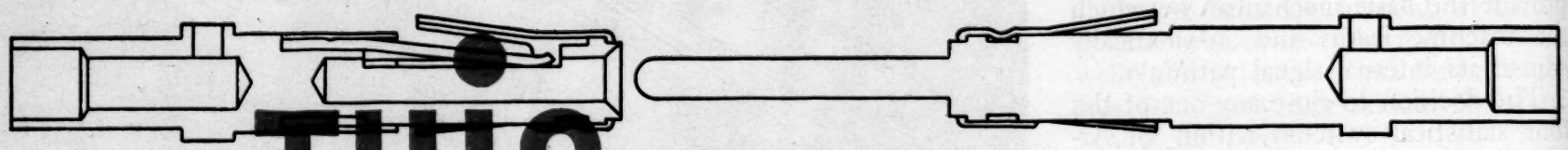
Lee compares this process of Artron network organization with Charles Darwin's theory of natural selection. He is not suggesting that the human brain necessarily operates on this principle, but that it is a means by which a brain could operate. "No one has ever proved that species did originate by natural selection," Lee says, "but the theory explains observed paleontological phenomena far better than any other scientific concept. This is the ultimate justification of a theory.

"The Artron concept can be extremely useful in developing higher order data handling and control processes," Lee believes, as well as helping to establish a "beachhead to put the life sciences on a mathematical basis."

The Bionics Computer Branch of WADD's Electronic Technology Laboratory has awarded two contracts to Melpar for work in this area. Under the first, to be completed late this year, Melpar will construct an operating Artron and will simulate the operation of large Artron networks using a digital computer.

The second WADD contract, to be completed early in 1962, provides for additional effort on developing Artron circuits and the construction of a small network of operating devices. Project Engineer at Melpar on the Artron program is Lewey O. Gilstrap.

IN RACK AND PANEL CONNECTORS



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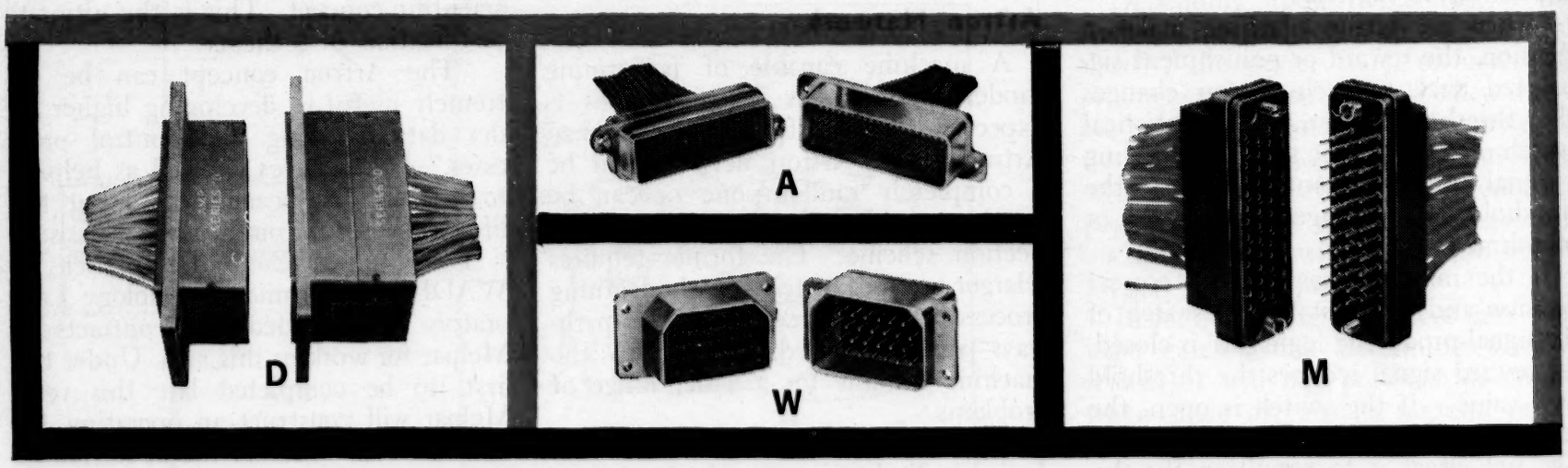

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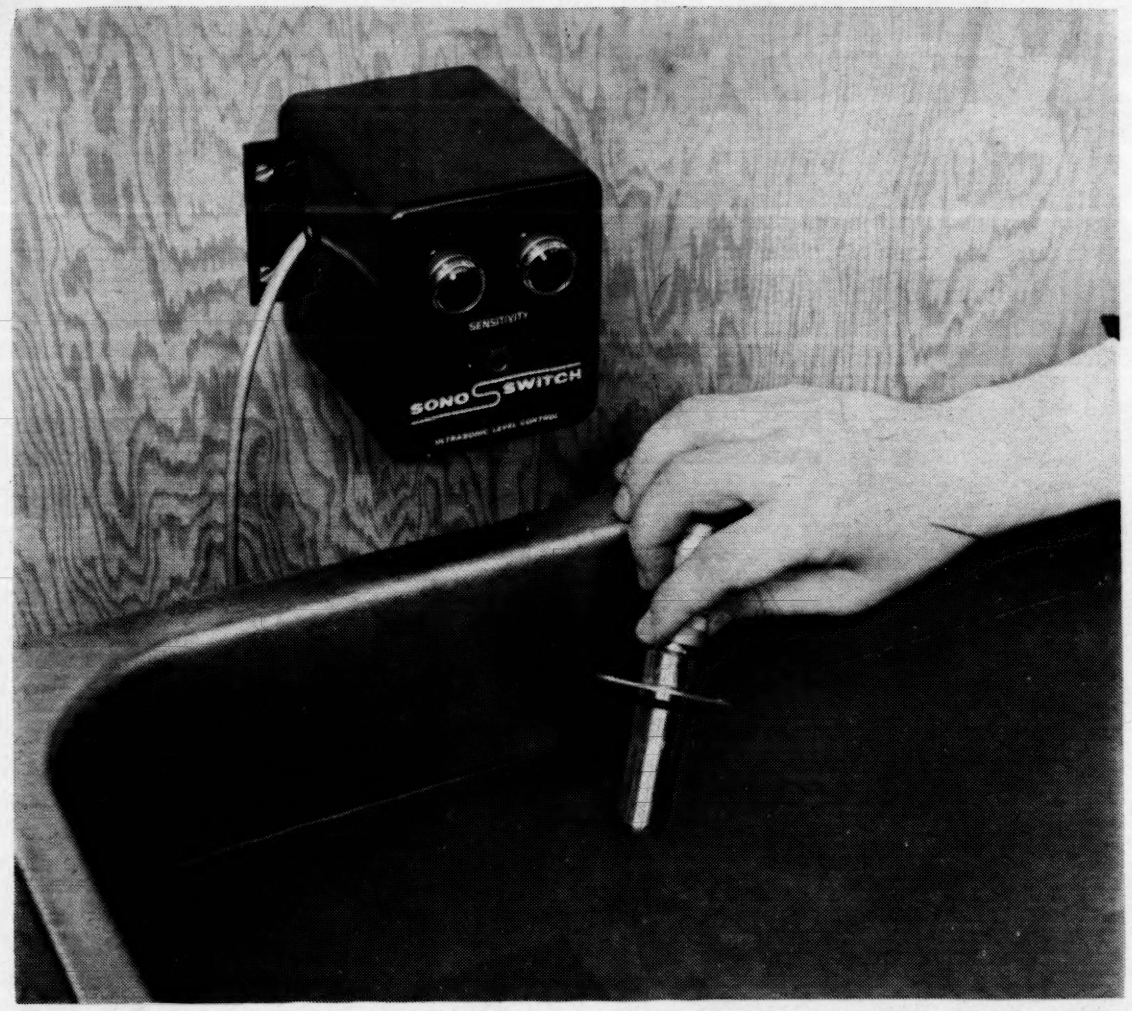


SONOSWITCH uses ultrasonics to detect presence or absence of liquid at tip of probe. Device weighs only 1 lb., costs $150. Probe can be used with jet or rocket fuels, water, corrosive acids. Device is planned for use on Saturn and Polaris submarines.

Ultrasonic Probe Detects Liquids

Garden City, N. Y.—New ultrasonic device, which can instantly sense the presence or absence of any liquid, is finding important uses in missiles and space vehicle booster applications.

The device, called Sonoswitch, was developed here by Powertron Ultrasonics Corp. It will be used in the Saturn clustered-engine booster to monitor pre-launch fueling and subsequently in flight to determine fuel level and consumption, according to William L. Blucke, company vice president.

Sonoswitch is being used to detect leaks in the missile firing chambers of Polaris submarines. It also is under evaluation by Douglas, Rocketdyne and Martin-Denver, which is considering its use in the Titan, according to Blucke.

The device can be used to detect the presence of a variety of liquids, including nitric acid, liquid oxygen, hydrogen, nitrogen, water, gasoline, oil, hydraulic fluid, radio-active slurries and high energy fuels.

Company currently is trying to interest aircraft manufacturers in applying Sonoswitch techniques to a system for automatically voiding outboard fuel tanks. Another possible aircraft application is as an automatic alarm when lube oil or fuel reaches a dangerously low level.

In the simplest configuration, Sonoswitch consists of a small ultrasonic probe and a transistorized controller. Combined weight of the two is about one pound. This basic configuration sells for about $150 and can provide a signal indicating either the presence or absence of a liquid at the tip of the probe.

A number of probes can be used to measure the liquid level within a tank by mounting each at a different level in the tank. The probes can be installed in any position.

Sonoswitch will not be falsely actuated by presence of foam, droplets or a film on the tip of the probe, according to Blucke. Its reaction time when probe tip becomes immersed or withdrawn from the liquid is within 10 milliseconds, according to the company.

The hermetically sealed, stainless steel probe contains a nickel rod which is caused to vibrate at ultrasonic frequencies (40,000 cps.) by means of a coil powered from a transistor oscillator in the controller. This vibration is produced by the magnetostrictive properties of nickel.

A second coil within the probe has a voltage generated in it by the vibration of the nickel rod. The signal generated is used to actuate a double-pole, double-throw relay in the controller. When the tip of the probe is immersed, the liquid serves to damp the probe vibrations, cutting the voltage in the output coil and causing the relay to be deactuated. The fact that the probe responds to the damping of the liquid rather than its "wetness" prevents it from being falsely actuated by foam, droplets or film.

Powertron Ultrasonics Corp. now is producing 10 different types of probes for a variety of different environmental conditions and applications. These include probes capable of operating at pressures up to 2,000 psi. and over temperature ranges as low as −420F and as high as 500F. Devices have passed MIL-S-901 and MIL-STD-167 shock and vibration tests, Blucke says.

The Sonoswitch operates either from 28 v. d.c. or 115 v. a.c. The 40 kc. signal supplied to the probe is at low voltage to minimize explosion hazard when used with fuels.

Powertron Ultrasonics Corp.'s address is Roosevelt Field, Garden City, L. I., N. Y.

Digitized Messages Cut Transmission Time

Culver City, Calif.—Conversion of messages into digital form through a device called "Digikey" can cut air-to-ground radio transmission time by about one half, according to Hughes Aircraft Co., developer of the system. Hughes claims that Digikey messages can get through heavy electrical interference by transmitting coded electrical pulses on several frequencies simultaneously.

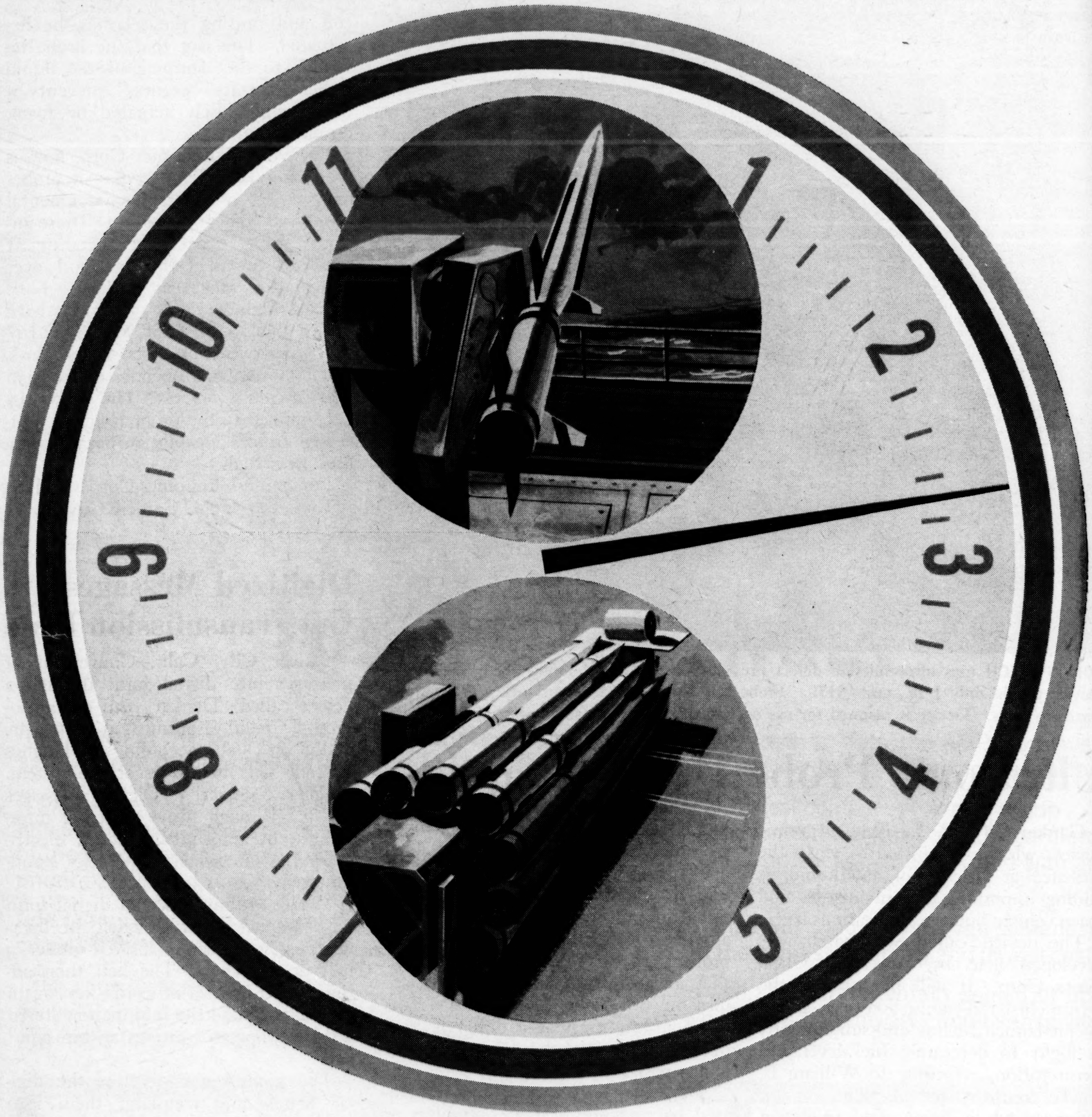
Words are impressed in digital form on a memory recorder when the operator presses buttons located under a belt or roll chart. The belt then advances to a new set of words, keys again are punched and the information stored until the operator presses a "transmit" key.

The ground unit receives the digital signals and translates them into printed information. Rate of transmission is 150 words per minute, or twice as fast as spoken transmissions.

For example, to send a weather report, the operator would punch the appropriate key and the Digikey automatically would send the aircraft's call letters and identification which are preset into the system's memory. Position, heading and altitude, fed to the Digikey automatically by the aircraft's instruments, also are transmitted.

The keyboard then advances to display a selection of words to describe visibility, followed by a series of symbols representing cloud types, and so on for as much information as required. The ground station receives the digital information and displays it in printed form, including the selected symbols.

Operating in conjunction with the



FROM REST TO READY....**LESS THAN A MINUTE**

■ Below deck, missiles are stored naked, stripped of stubby wings. But in less than 60 seconds they're assembled, loaded and fired, thanks to automation. ■ Take this concept – develop the idea into today's mighty missile systems. Vitro did: its technical staff helped the Bureau of Naval Weapons design fully-automated missile handling and launching systems – ones now used aboard frigates, cruisers and carriers armed with fast, ship-launched Terrier and Talos missiles. ■ Vitro scientists and engineers went right to work during basic ship design – providing space needed for automatic storage and handling. Beyond this, Vitro takes ideas and develops actual systems for feasibility testing.

Vitro

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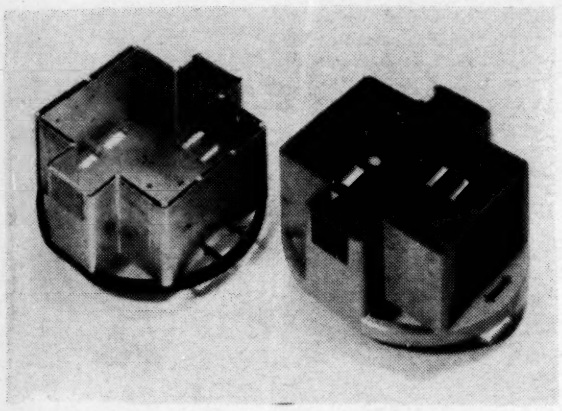
SCIENTISTS AND ENGINEERS: JOIN THIS TEAM

Hughes-developed long-range communications system, HACON, now operational in the Convair B-58 Hustler, Digikey and a digital converter overcome the difficulty of transmitting through heavy electrical interference by breaking up a message into a series of coded electrical pulses which are transmitted over several frequencies. Only a few pulses need get through for the receiver to recognize the character transmitted. This allows large volumes of information to be sent in a short time with reduction in chances for human error or ambiguity, Hughes says.



ASTROPLEX foam-in-place computer housing at left weighs 10 lb. 6 oz., is completely interchangeable with cast magnesium housing at right which weighs 27 lb. 4 oz.

Computer Housings Developed for Polaris

Foam-in-place construction of computer housings for the Polaris missile is the first application of this technique to the electronics industry, according to Astro Dynamics, Inc., Cambridge, Mass., developer of the technique. Astro Dynamics claims that the aluminum sandwich housings are 60% lighter than the cast magnesium housings now used in the missile and are completely interchangeable with the cast housings.

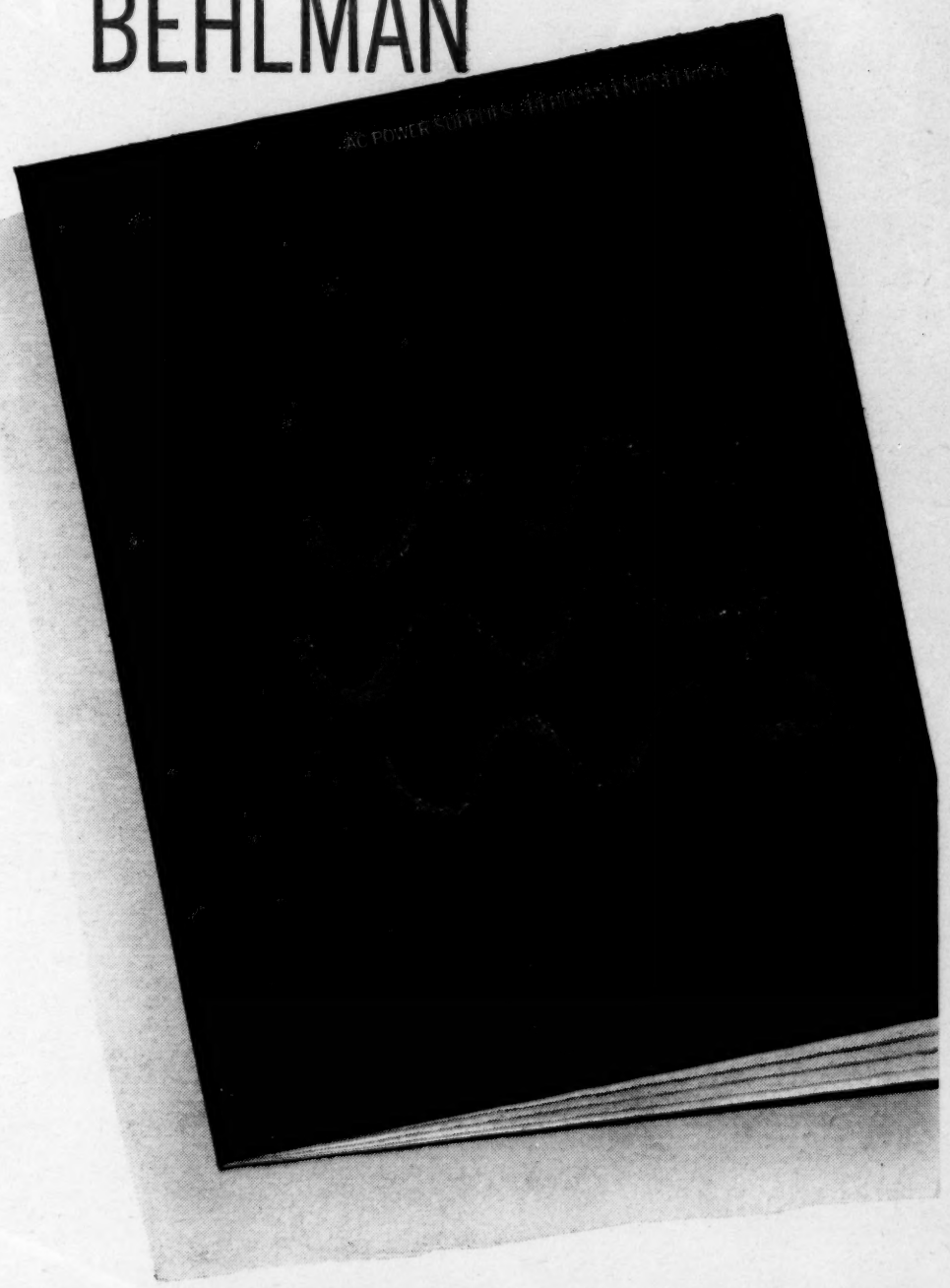
Key to the process, known as Astroplex, is the dimpling and riveting of the sandwich walls, a process developed by Astro Dynamics to enable the lighter housings to maintain high strength and rigidity.

The rivets take up the shear forces in the sandwich construction that are usually borne by the cement in foam-in-place fabrications.

The unit, which contains stainless steel cooling tubes and has over 250 inserts for nuts, spacers, rivets and locating pins, is fabricated by bringing together two thin aluminum structures —.020 in. aluminum outer skin is suitable for missile environments—supported by steel dies, with polyurethane foam between them.

In the Astroplex process, operation and curing temperatures are kept low enough to permit the aluminum to retain its original temper, thereby adding to the strength of the finished unit.

YOURS FOR THE ASKING... AC POWER FROM BEHLMAN



Behlman is offering this guide to AC power supplies as a service to those engineers who have a need for extremely accurate and exceptionally stable AC power — single, two and three phase. For your free copy, send the coupon below to: **Behlman Engineering Company, 2911 Winona Ave., Burbank, Calif.**

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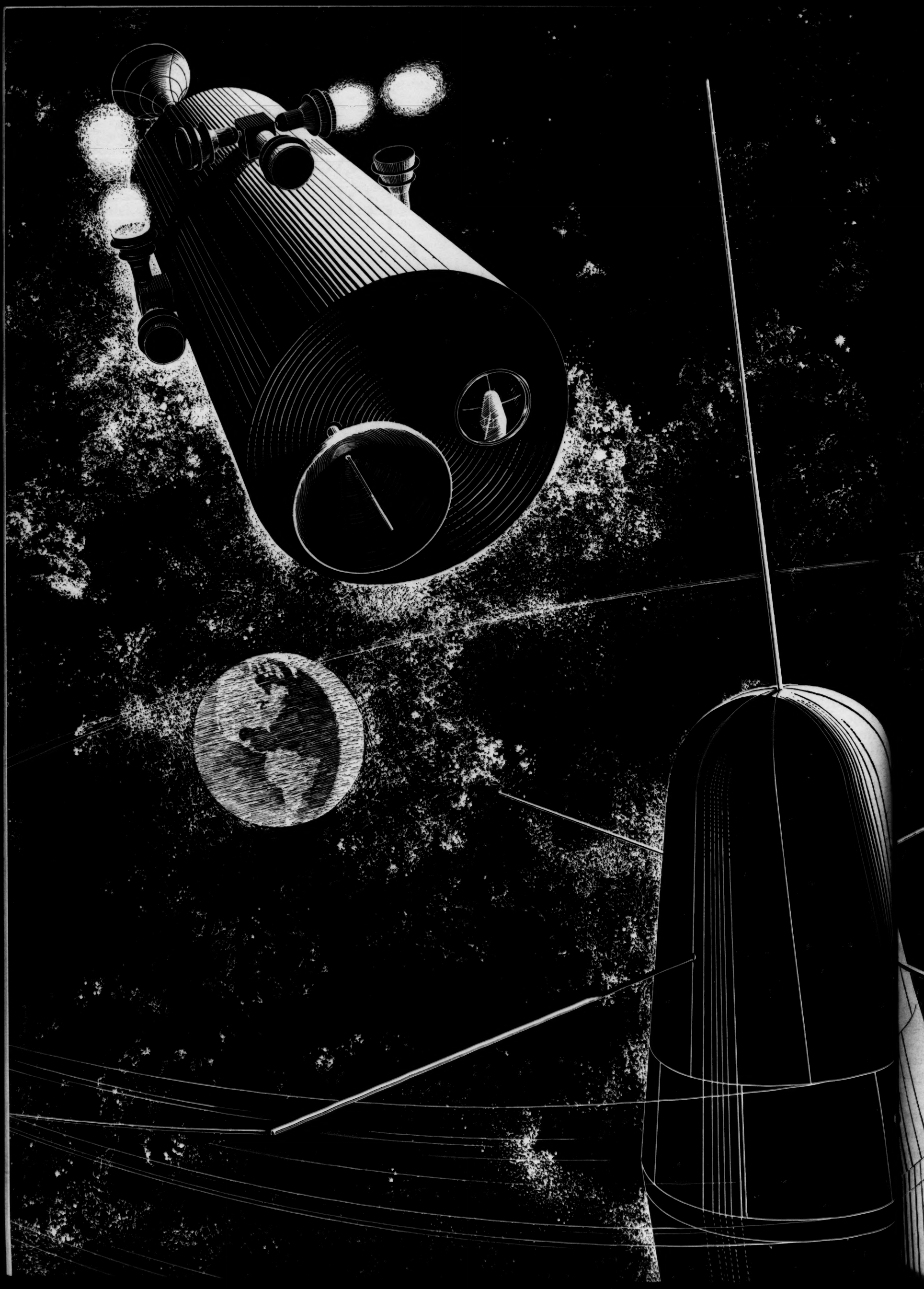


SPACE RENDEZVOUS

New PAT-C Applications Demonstrate Marquardt's Capability in Precision Controls

Typical of Marquardt's Control Systems capable of meeting the sophisticated requirements of today's weapon and scientific vehicles is the Corporation's Position-Attitude-Trajectory Control System.

Already selected for one satellite project, the Marquardt PAT-C System provides the exacting control required for space vehicle rendezvous. Whether it's an intercept, observation, maintenance, rescue, or destruction mission, PAT-C makes possible the accurate positioning of heavier payloads in space.

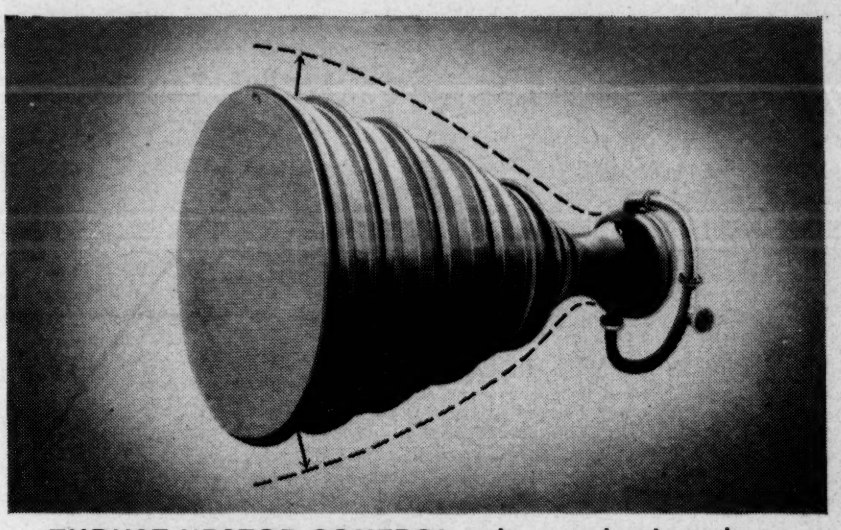
PAT-C is a highly responsive jet reaction system which controls the Position, Attitude and Trajectory of space vehicles as a result of inputs from the vehicle guidance system or ground control signals. The system provides the extremely precise corrective action based on simple position and velocity error signals, or will respond to the demand of guidance computers in the system. Tests demonstrating the flexibility of the PAT-C system range from multiple restarts up to 200 times per second to four minutes of continuous operation on a radiation cooled thrust chamber and nozzle.

Marquardt's sixteen years of research and development has produced state-of-the-art advancements over a wide range of electronic, electro-mechanical, pneumatic, hydraulic and nuclear controls and accessories.

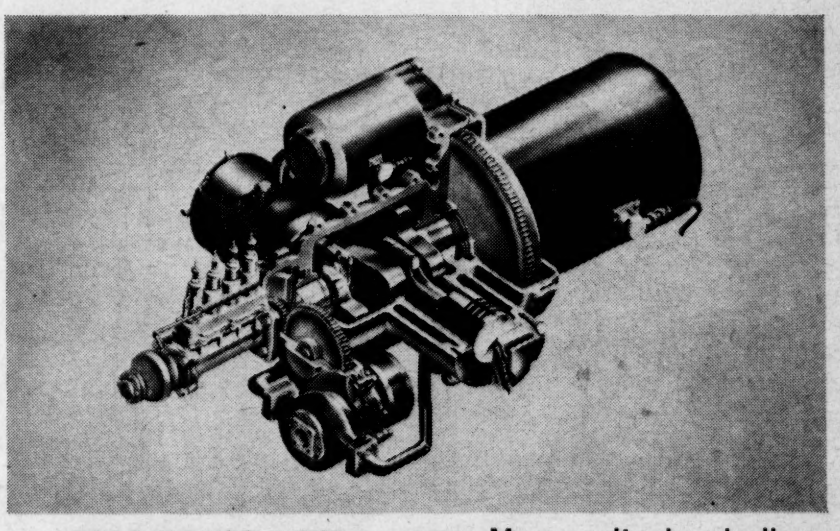
For example, products demonstrating the company's diversified capability include: gas operated servo systems for thrust vector control of an advanced ballistic missile; inlet controls for the McDonnell F4H-1 and the North American Hound Dog (GAM 77); a radically new space power unit; and control systems for the Bomarc ramjet engine and the Project Pluto nuclear ramjet engine.

For additional information concerning the PAT-C system or other controls capabilities contact Dick Oblinger, Chief Application Engineer, Controls and Accessories Division.

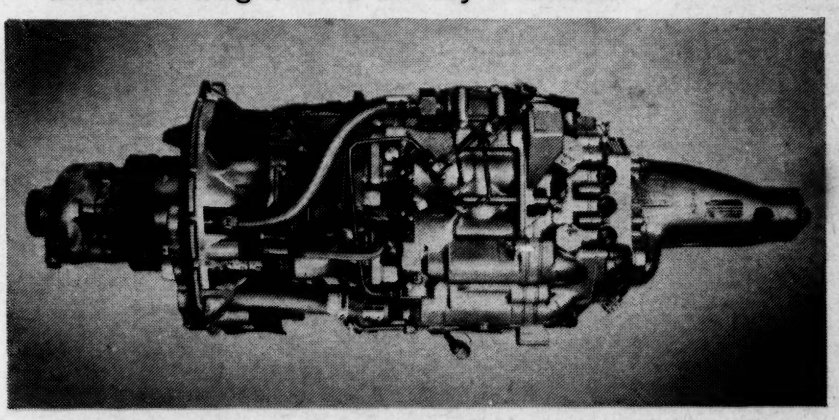
Engineers and scientists experienced in these or related fields will find it rewarding to discuss their career futures with Marquardt.



THRUST VECTOR CONTROL rotary actuators have been tested up to 1600 degrees F. and up to 42 hours.



SPACE POWER UNIT—a new Marquardt chemically fueled fixed displacement unit provides power with minimum weight for 1-15 day missions.



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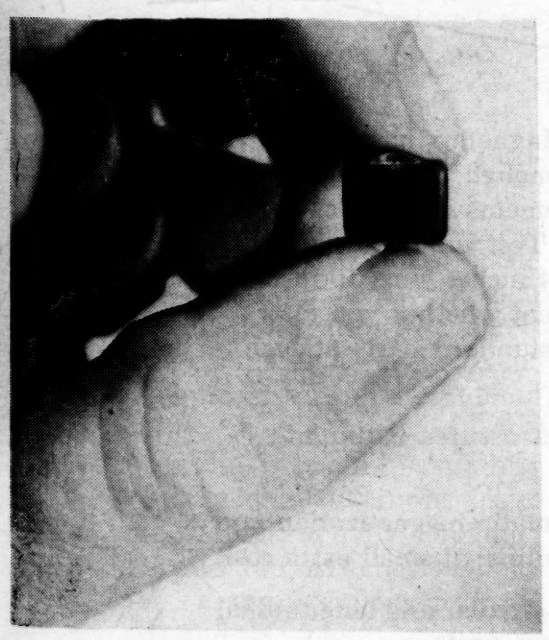
FILTER CENTER

▶ **Space Surveillance Gap to Be Plugged** Navy will install a new 560-kw. transmitter near Wichita Falls, Tex., feeding a mile-long antenna to plug gap in Navy Space Surveillance System stretching across the southern part of the U. S. Powerful new transmitter, to be built by Radio Corp. of America, and the huge antenna, to be supplied by Antenna Systems, Inc., will illuminate satellites passing overhead. Reflected signals will be capable of being received simultaneously by four receiving stations, two in the southeast part of the country spaced 500 mi. apart, and another two similarly spaced stations in the southwest.

▶ **Novel High-Speed Memory Developed**—New solid-state storage device, which uses phenomenon known as "persistent internal polarization," or p.i.p. for short, with write-in and read-out time measured in fractions of a microsecond, has been developed by New York University scientists, under sponsorship of Office of Naval Research. Data is stored on a phosphor photoconductive surface layer by applying a voltage and exposing entire layer to a flash of light, then selectively irradiating desired spot where information is to be stored. Alternatively, data



Tooth Transmitter

Tooth transmitter, a microminiature radio transmitter intended to be mounted in a dental bridge to measure number of closures, grinding and tooth pressure, was developed for USAF Aerospace Medical Center by Varo, Inc., Garland, Tex. The tiny transmitter measures only 0.026 cu. in., including battery, and weighs only 1.2 grams. Transmitter also can be enclosed in capsule and swallowed to permit monitoring of digestive processes in the body. Transmitter range is about three feet.

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Until Stromberg developed the new TRANSACTER System, no accurate, instantaneous method of source data collection existed. Industrial data collection and transmission was a relatively primitive operation — dependent on manual recording and delivery — subject to human fallibility every step of the way. Such methods were incompatible with the accuracy and efficiency of EDP and computer speeds.

The TRANSACTER System eliminates the paper work between widely scattered data sources and a central processing office. Management reports that have taken days — sometimes weeks— can now be produced in minutes! With the TRANSACTER System dramatic new opportunities for profit improvement become evident.

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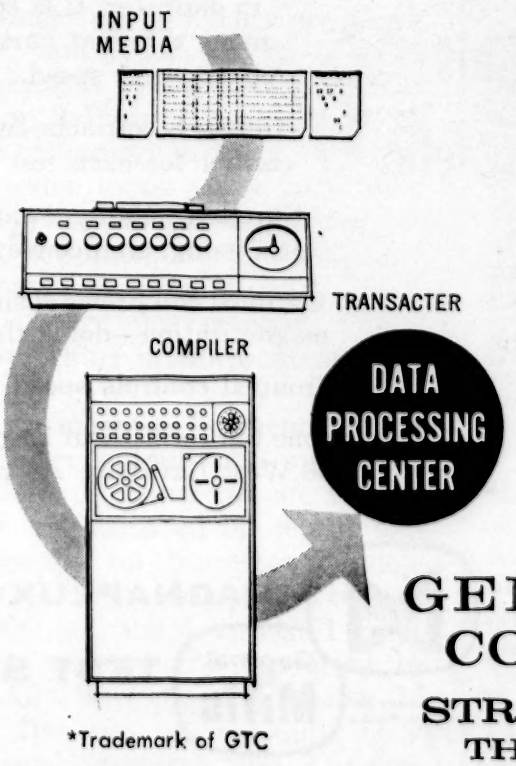

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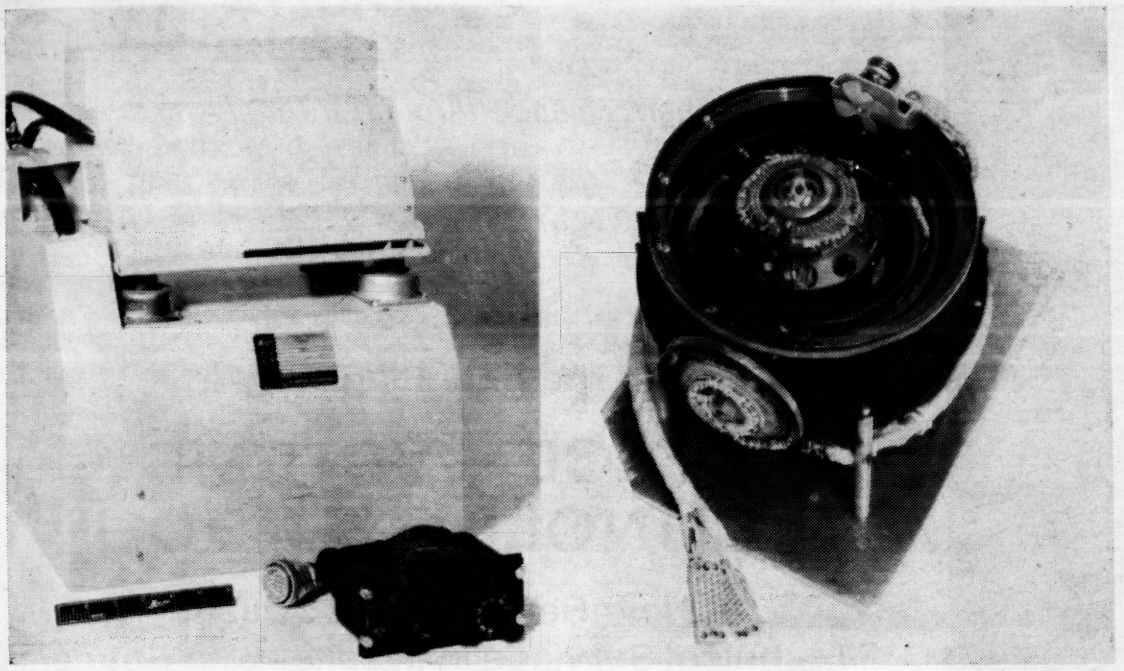

Inertial Reference System Designed for F-104J

Inertial reference system for F-104J fighters purchased by Japan, provides precise heading and vertical reference signals for autopilot, radar, navigation equipment and gunsight. Developed and produced by Kearfott Division of General Precision, Inc., complete system weighs only 45½ lb. and occupies 1.15 cu. ft. Shock-mounted case atop stable platform contains transistorized amplifiers and controls. Entire package is configured to curvature of aircraft for optimum space utilization. Stabilized platform (right) has four gimbals to permit unlimited aircraft maneuvers. Platform uses three single-axis, non-floated integrating gyros and two accelerometers. Vertical reference is accurate to within 0.25 deg., Kearfott says, under unaccelerated flight conditions. Earth rate correction is provided to permit heading gyro to operate without magnetic reference at high latitudes.

can be stored by first irradiating entire phosphor layer then selectively applying voltage and light to desired spot. Presence or absence of polarization voltage on surface of layer indicates presence or absence of stored data. Several readouts are possible before stored signal is washed out. Device operates at room temperature.

▶**Navy Tests Radio Duct Communications**—Navy scientists have successfully transmitted both VHF and UHF signals between California and Hawaii, a distance of 2,600 mi., as part of their tests on radio propagation via ducts formed between dry and wet air layers. This duct climbs from an altitude of about 1,000 ft. over San Diego to 7,000 ft. above Hawaii. Test results currently are being analyzed to determine effect of weather frontal activity on duct propagation and the existence of holes in the duct. Transmissions were made at both 220 and 445 mc.

▶**New Surface Passivation Technique**—A new, simple, low-temperature technique for passifying the surfaces of semiconductors so they are not easily contaminated has been developed by Motorola Semiconductor Products in Phoenix, Ariz. Differing from surfaces passivation approaches of Pacific Semiconductors and Bell Telephone Laboratories, the Motorola process is performed at atmospheric pressure, at temperature of 500C and is completed in ½ hr.

▶**Tunnel Emission Amplifier**—An amplifier which employs the tunneling effect in metals and metal oxide films at room temperature will be investigated by Electro-Optical Systems, Inc., under a $49,454 contract from the Electronic Technology Laboratories at Wright Air Development Division. The tunneling process was observed and analyzed in metals and their oxides by scientists at California Institute of Technology.

▶**Navy Seeks High-Temperature Circuits**—Circuit packages which can resist extreme environments are to be fabricated and evaluated on a pilot production basis by the Navy's Avionics Facility in Indianapolis as part of an advanced technology program. Initially, ceramic wafer tubes rather than transistors will be employed because of superior performance in tough environments. Eventually, the Navy hopes to merge this program with a companion effort in microcircuitry.

▶**Pushing Transistor Frequency/Power Limits**—Power output and upper frequency limits of transistors are steadily going up as evidenced by recent proposal requests for transistor development efforts. Some examples: a 10 watt unit at 400 mc. and 1 watt at 1 kmc., a two-year effort to be supported by Wright Air Development Division; 25 watts at 100 mc., an upcoming U.S. Army Signal Research and Development Laboratory Contract.

Ideas you can use from

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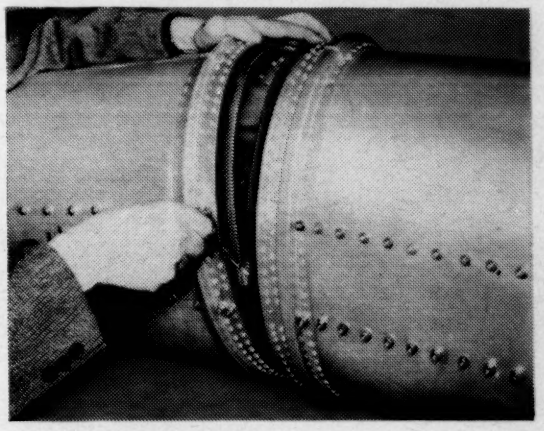

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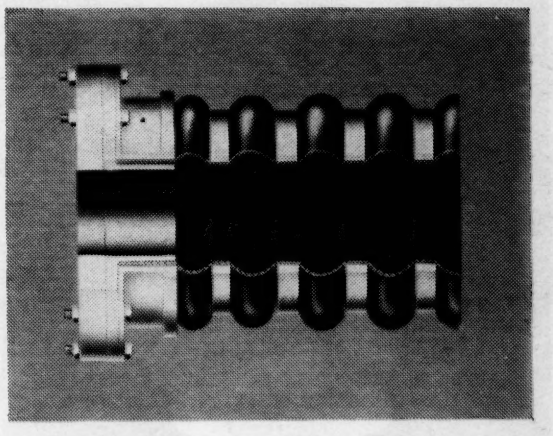

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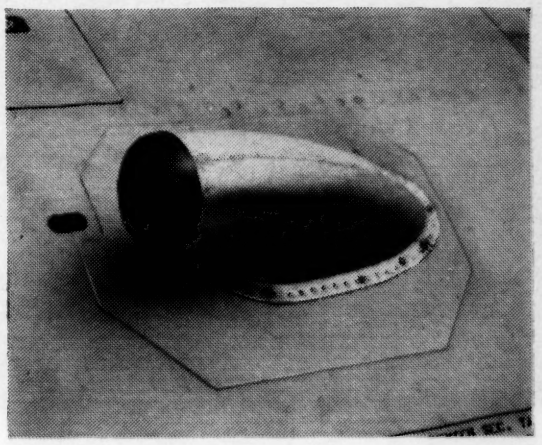

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For more information check your B.F.Goodrich Aviation Products Representative, or write *Aviation Products, a division of The B.F.Goodrich Company, Dept. AW-2B, Akron, Ohio.*

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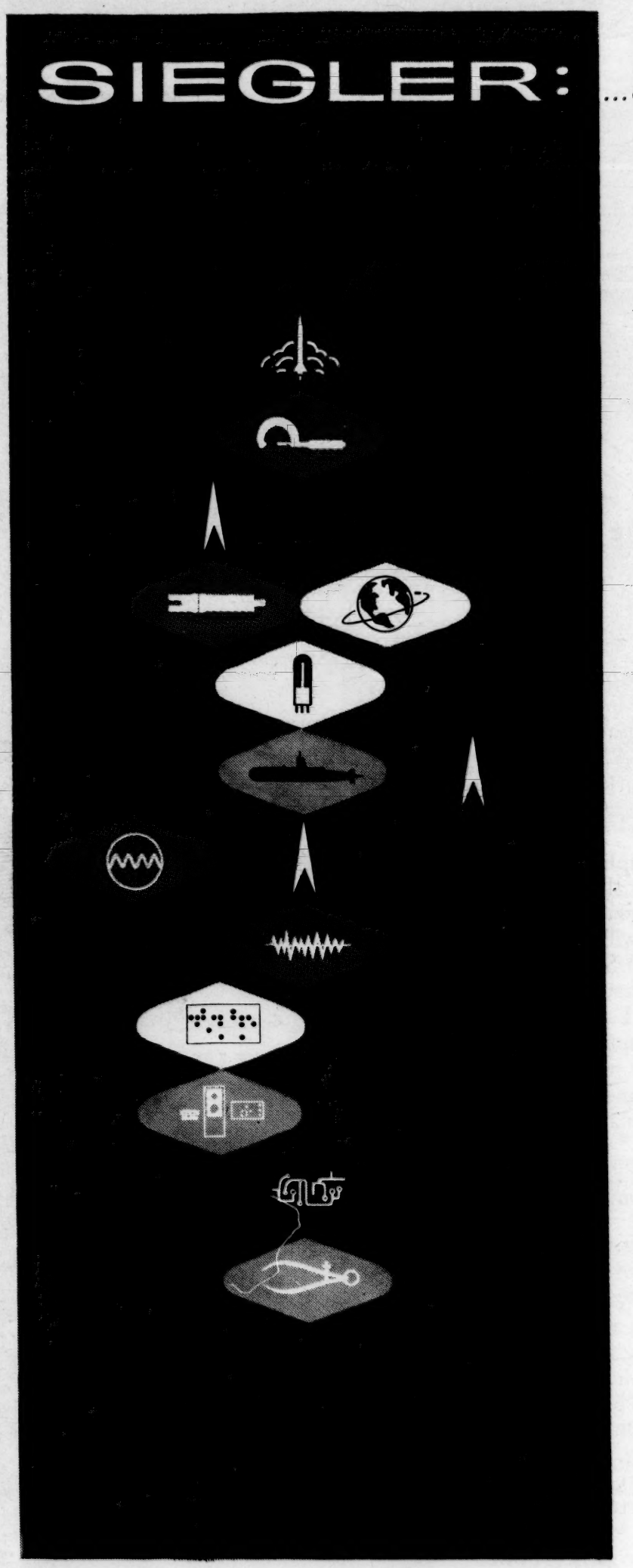

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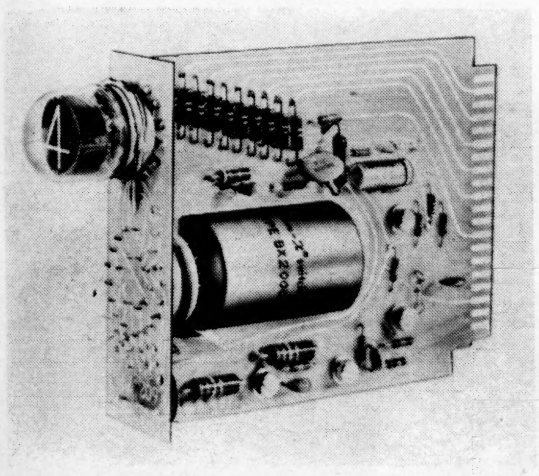
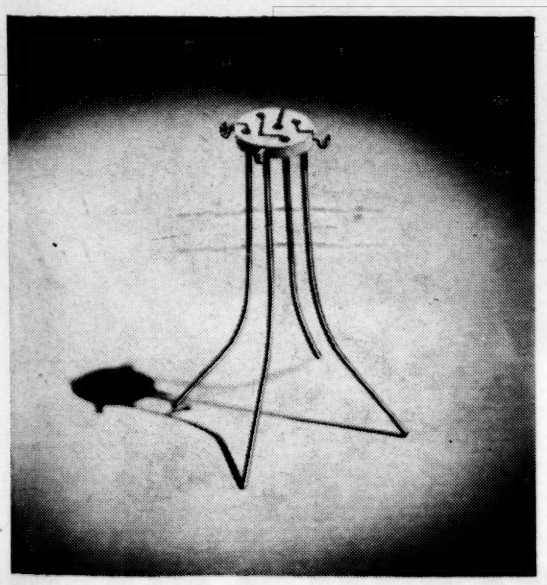
• **Transistorized decade counter,** Type DC-114, designed to operate at frequencies up to 110 kc., provides both visual readout and 10 individual constant-current outputs for printing, gating or presetting. Use of new shielded

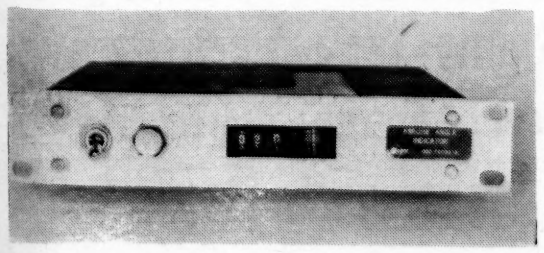


switch permits decade counters to be stacked side-by-side without magnetic interaction. Counters can be directly cascaded and driven by 12-v. signal. Price is $100. Manufacturer: Burroughs Corp., Electronic Tube Div., Box 1226, Plainfield, N. J.

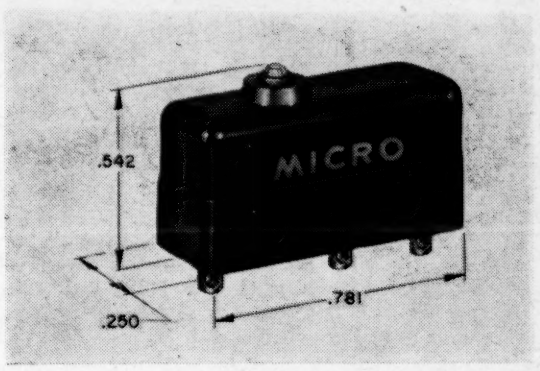


• **Printed circuit substrates,** consisting of small "Mykroy" slabs with leads molded in position and surfaces lapped to a 10-micro-inch finish, can be used for depositing resistance and conductive surfaces. Also available is Mykroy glass-bonded mica on which copper conductive circuits can be deposited. Manufacturer: Electronics Mechanics, Inc., Clifton, N. J.

• **Precision angle indicator,** Model CO-2721011, can read out the shaft position of a synchro or resolver to within 6 min. of arc. Device has repeatability of 1.2 min., sensitivity of 1.0 min. and can be read to within 0.5 min. Tester measures 9½ x 9⅛ x 1¾ in., weighs 4 lb. Manufacturer: Kearfott Div., General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.



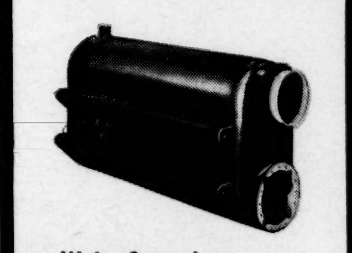
• **Sensitive subminiature switch,** capable of maintaining a differential travel within 0.001 in., has maximum operating force of 3½ oz., release force of 1 oz. maximum, overtravel of 0.003 in. minimum and a 0.008 in. minimum break travel. Electrical rating is 3 amp. inductive or 5 amp. resistive at 30 v., with 24 amp. maximum inrush. Switch has a UL listing of 5 amp. at 125 or



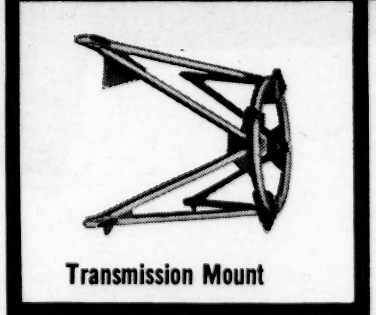
250 v.a.c. Manufacturer: Minneapolis-Honeywell, Micro Switch Div., Freeport, Ill.

• **Co-axial switch,** Model TS-1, a DPDT unit covering frequency range

TIROS Structure

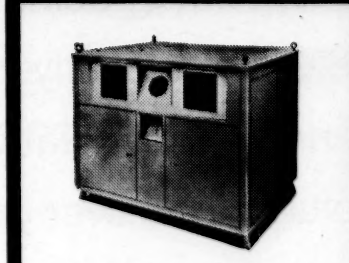


Water Separator



Transmission Mount

Electronic Frame



Missile Support Cabinet

Photo courtesy Radio Corporation of America

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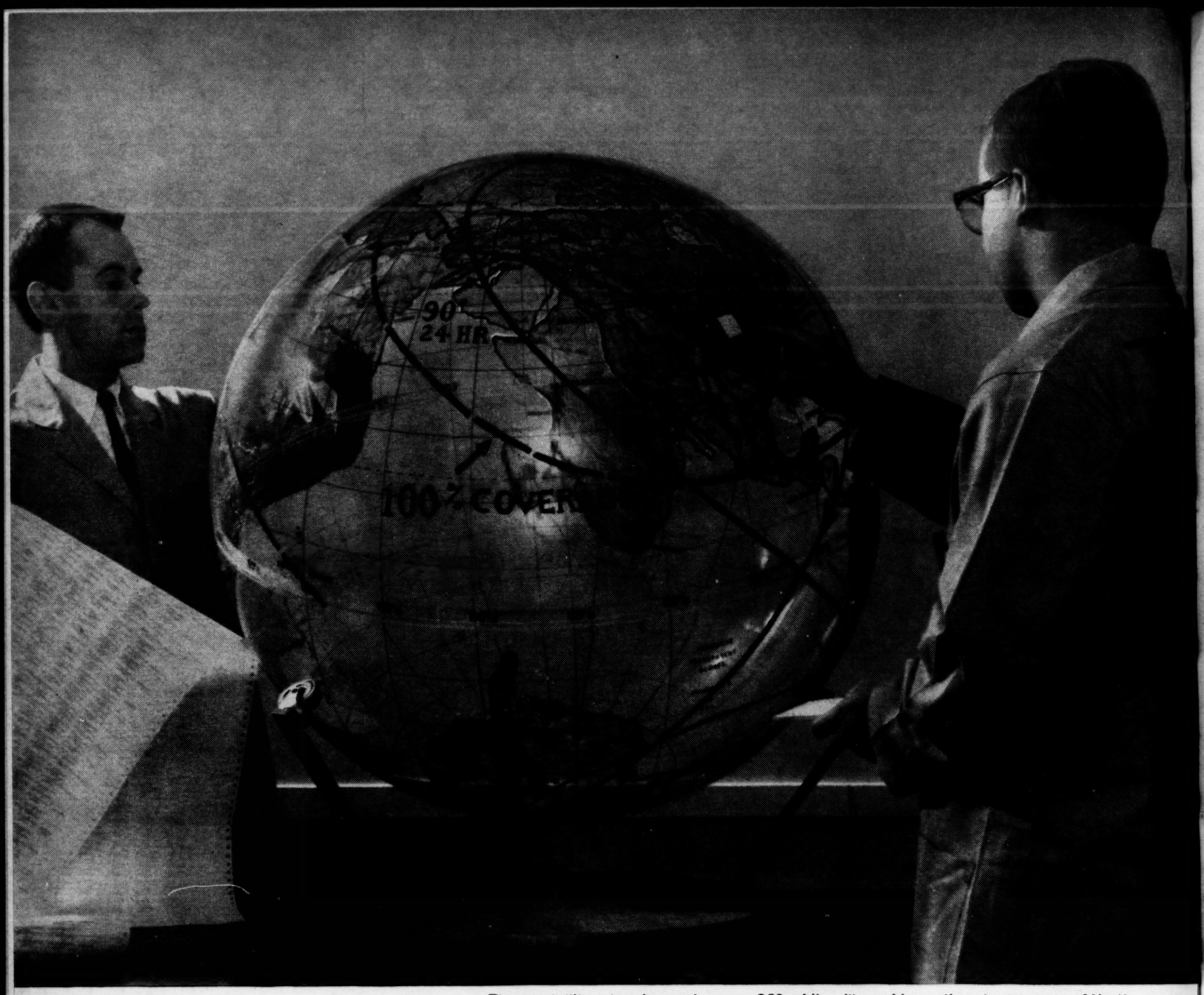

Three satellite relays in synchronous 90° orbits will provide continuous coverage of North America and polar regions from a ground station located in the central United States.

TIMETABLES FOR SATELLITE RELAYS are computer print-outs by which Bendix predicts, second-by-second, when communications could be implemented in complex configurations of earth and space terminals. Such timetables are essential to the selection of orbits and number of satellites required for military and civilian systems. They also provide key data for the economic analysis and operational control of satellite communication systems which offer career opportunities for better scientists and engineers.

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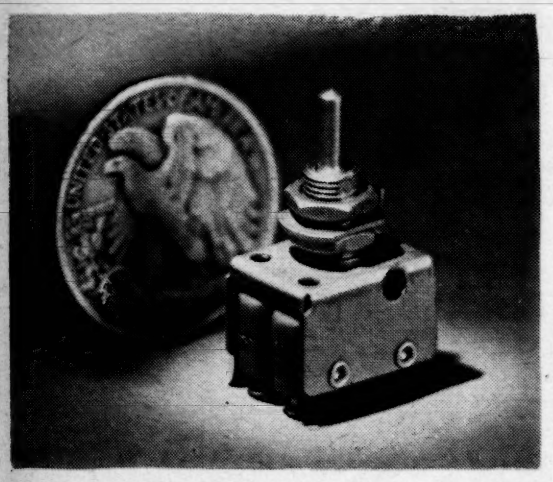
from d.c. to 1,000 mc., and usable to 1,500 mc. Switch has VSWR less than 1.1 to 1,000 mc. and an insertion loss less than 0.1 db. over same range. At 1,000 mc., cross talk is less than 70 db. Switch is constructed so that additional units can be added by tandem stacking to handle eight or more separate RF circuits, if necessary. Manufacturer: Telonic Industries, Inc., Beech Grove, Ind.

• **Miniature three-position toggle switch,** Type B-T1-3P, with dimensions of 0.78 x 0.66 x 1.36 in., is available in a variety of contact ratings, up to 10



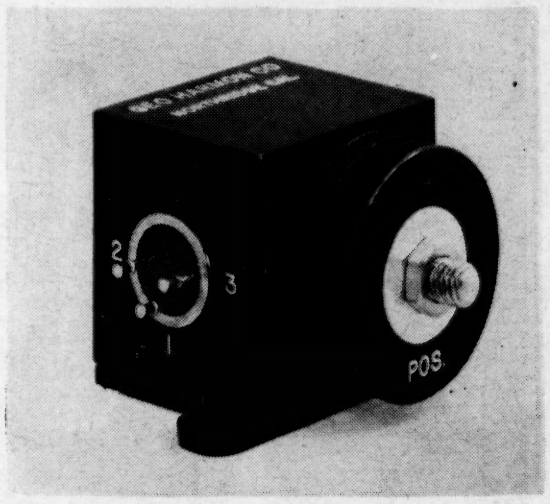
amp. at 125 v.a.c., or 5 amp. at 240 v.a.c.; 10 amp. resistive or 8 amp. inductive at 30 v.d.c.

Manufacturer: The Milli-Switch Corp., Gladwyne, Pa.

• **Analog-to-digital converter,** for direct conversion of transducer signals into digital outputs, is available in two types. The El-Con converter, a pulse-duration-modulation (PDM) device, responds to an interrogating pulse with a new pulse proportional in duration to the transducer input voltage. The Micro-Con converter responds to a chain pulse interrogation by producing an output pulse train where number of pulses is proportional to the transducer input voltage. Accuracies are available to within 0.1% absolute. Application details are available from manufacturer: Electro-Logic Corp., 515 Boccaccio Ave., Venice, Calif.

• **Subminiature film capacitors,** available with temperature coefficients from zero to 120 ppm/deg.C for precise matching with precision resistors or inductors, have self-healing characteristics of metallized film capacitors. Units are available either with Teflon or Mylar foil, to tolerances of 0.1%. Manufacturer: Component Research Co., 3019 So. Orange Drive, Los Angeles 16, Calif.

• **DC Static time delay contactor,** with no moving parts, can handle currents up to 70 amp. with time delay of 0.001 to 120 sec., or longer if required. Operating voltage is 28 v.d.c., but unit also



is available with voltages up to 280 v.d.c. Device weighs 3 oz., is designed to meet or exceed MIL-E-5272C, according to manufacturer: George Harmon Co., Inc., 18141 Napa St., Northridge, Calif.

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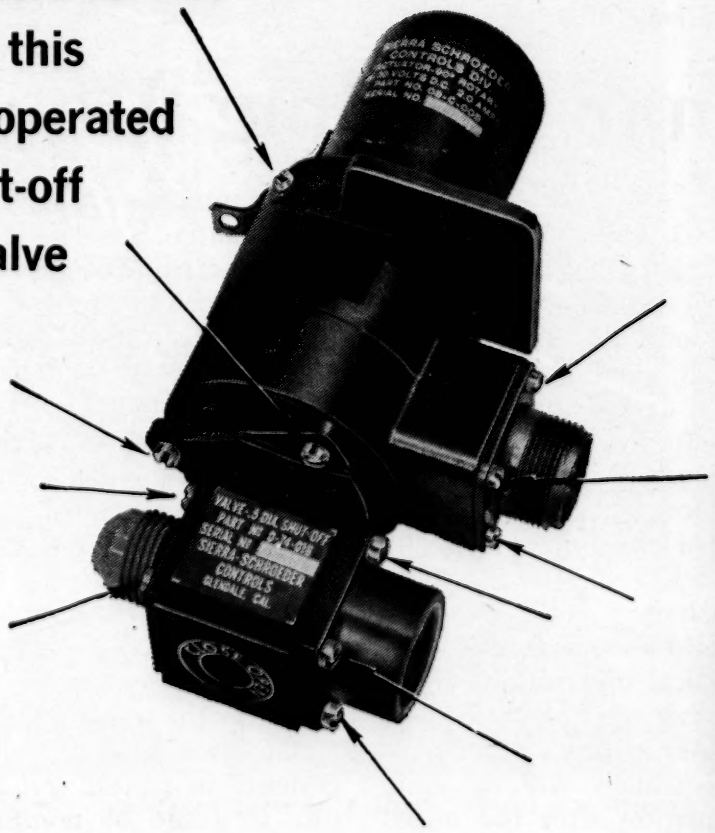
simplify assembly and field service on this motor operated shut-off valve



Use of Long-Lok Self-Locking Screws on this Sierra-Schroeder Controls Model 74-01B Valve eliminated lock wire, provided repeated re-use — simplified field service. Long-Lok Self-Locking Screws are used on the housing of this valve as well as on the gear train mounting where an extremely restricted assembly area makes the use of lock wire a time consuming and prohibitively expensive operation.

Long-Lok Self-Locking Screws can speed and improve your assembly operations — provide important savings in time and labor — assure highest reliability.

Available in all head sizes and styles — have wide temperature range — qualified to MIL-F 18240 specifications — head marked for self-lock identification.

If you have a fastener problem, Long-Lok can help you.

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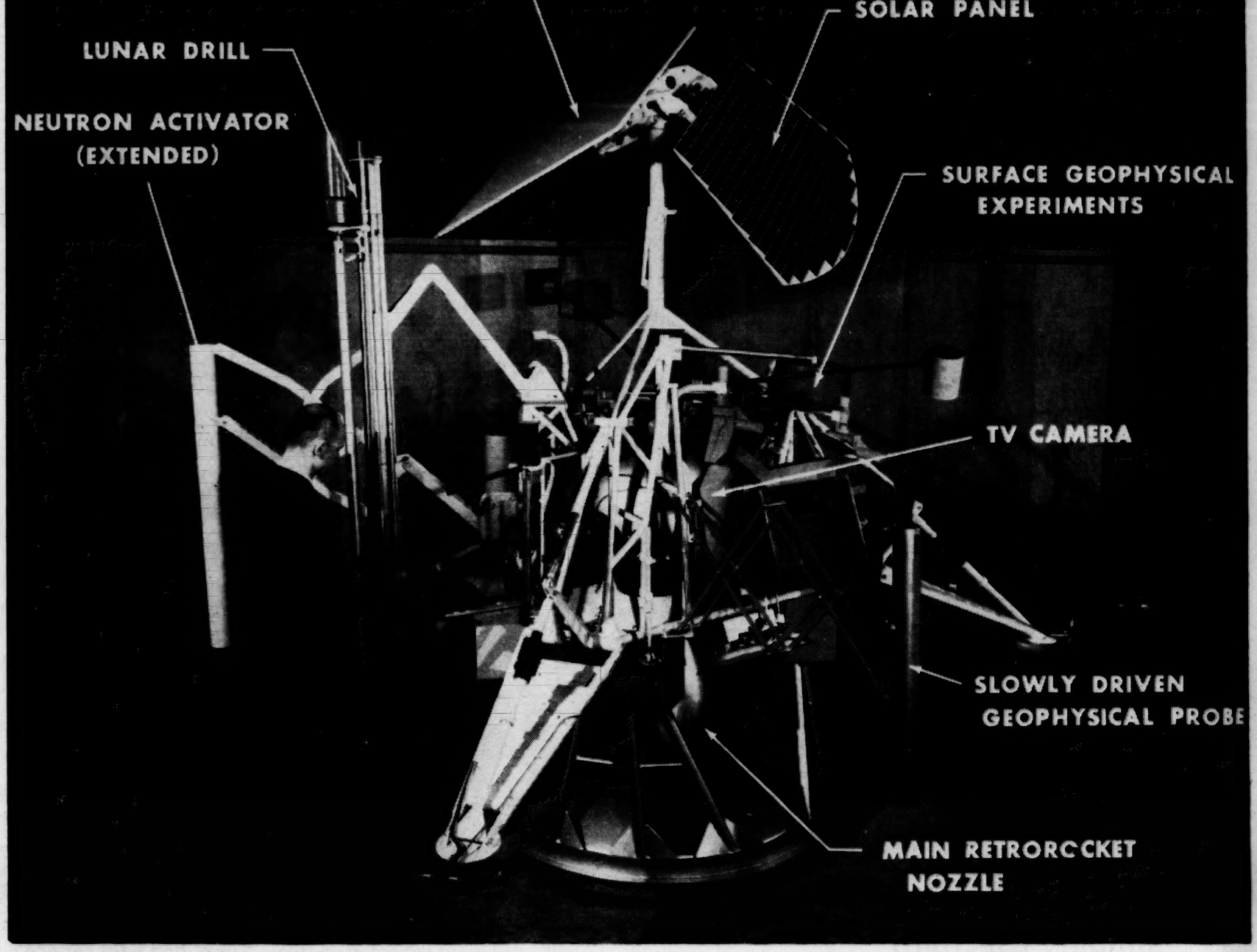


HUGHES AIRCRAFT CO. entry into the Surveyor spacecraft competition is shown in full-scale mockup. The 11-ft. Surveyor will soft land about 750 lb. on the moon; about 30% of the payload will consist of instruments and the supporting devices needed to make them work. Launch is tentatively scheduled between 1963-1966 (AW Jan. 30, p. 25).

Hughes Unveils Lunar Landing Mockup

By Russell Hawkes

Pasadena, Calif.—National Aeronautics and Space Administration's Surveyor soft landing vehicle for lunar exploration (AW Jan. 30, p. 50), will make a dozen or more types of observation and will weigh only about 125 lb. as it touches down on the moon, according to scientists at California Institute of Technology's Jet Propulsion Laboratory and prime contractor, Hughes Aircraft Co.

On earth, where the force of gravity is six times greater than on the moon, Surveyor would weigh about 750 or 800 lb. in its landing configuration. About 30% of the landing weight will consist of instruments and the unusual supporting devices needed to make some of them work. Since the first of seven Surveyor vehicles is to be launched no sooner than 1963, there will be time to alter the vehicle design and the program of lunar experiments, but JPL and Hughes officials believe the mock-up unveiled here last week is very close to the final design and expect no radical changes in the list of observations to be telemetered to earth. The list will include four categories:

- **Visual study of the lunar landscape** and surface by television.
- **Lunar soil analysis.**
- **Particle and field measurements.**
- **Lunar geophysical observations.**

Most of the observations will be made on command from a control center on earth but there usually will be some degree of automation after the initial command. Command receivers aboard Surveyor will use a pair of small crossed-dipole antennas. A bigger, highly directional antenna used for telemetering data to earth would ordinarily not be used to receive commands because earth-based transmitters can be powerful enough to make high-gain receiver antennas unnecessary.

The observations making the heaviest demands on the ingenuity of instrument designers are the analyses of the chemical make-up of lunar soil. To do this it will be necessary to bore a hole in the soil, collect a sample, process it in several ways, distribute it to various instruments, make the analyses, and telemeter the results—all by remote command. Designers have little or no experience in remote soil analysis to rely on. It would be pointless to make a remote analysis on earth where there are easier ways. The first attempt to

do it will have to be made within the stringent limitations on weight and power requirements which the lunar mission imposes.

Since the whole vehicle will weigh only about 125 lb. in the moon's gravity field, it will be impossible to place a heavy downward force or a high torque upon Surveyor's drill, without causing the vehicle to tip or jump. The drill will be expected to penetrate between 18 in. and 60 in. into the lunar surface. The power available to drive the drill will be relatively slight by terrestrial standards. JPL and Hughes have not yet made a firm decision on whether to use a photovoltaic solar power system or radioisotope thermoelectric generator (RTG) units.

The drill will be mounted upon a collapsible pantagraph structure so that it can be held in close while covered by the aerodynamic nose cone of the Centaur launch vehicle and then extended to drill its hole on the moon. A second pantagraph structure mounted upon the drill frame will carry a neutron activator to make the soil in the hole radioactive by bombarding it with a stream of neutrons. A soil sample will then collect activated soil and carry it to a material pulverizer and distributor that feeds the various instrument specimens for analysis. Neutron activation changes the reaction of chemicals to fields and particle bombardments in different degrees which can be measured by instruments. Surveyor instruments will include a mass spectrometer and an X-ray fluorescence spectrometer. Organic molecules will be detected by gas chromatography.

Surveyor will carry four vidicon cameras fixed rigidly to its tripod structure. Three will point straight up and the other will point down. A gimbal-mounted mirror in front of each lens will enable each upward-pointed camera to pan through 360 deg. of azimuth and cover a vertical sector between 15 deg. above and 45 deg. below the horizontal plane of the Surveyor structure. At least one camera will probably shoot color. Frame rate at which pictures will be telemetered to earth will be only one every few seconds.

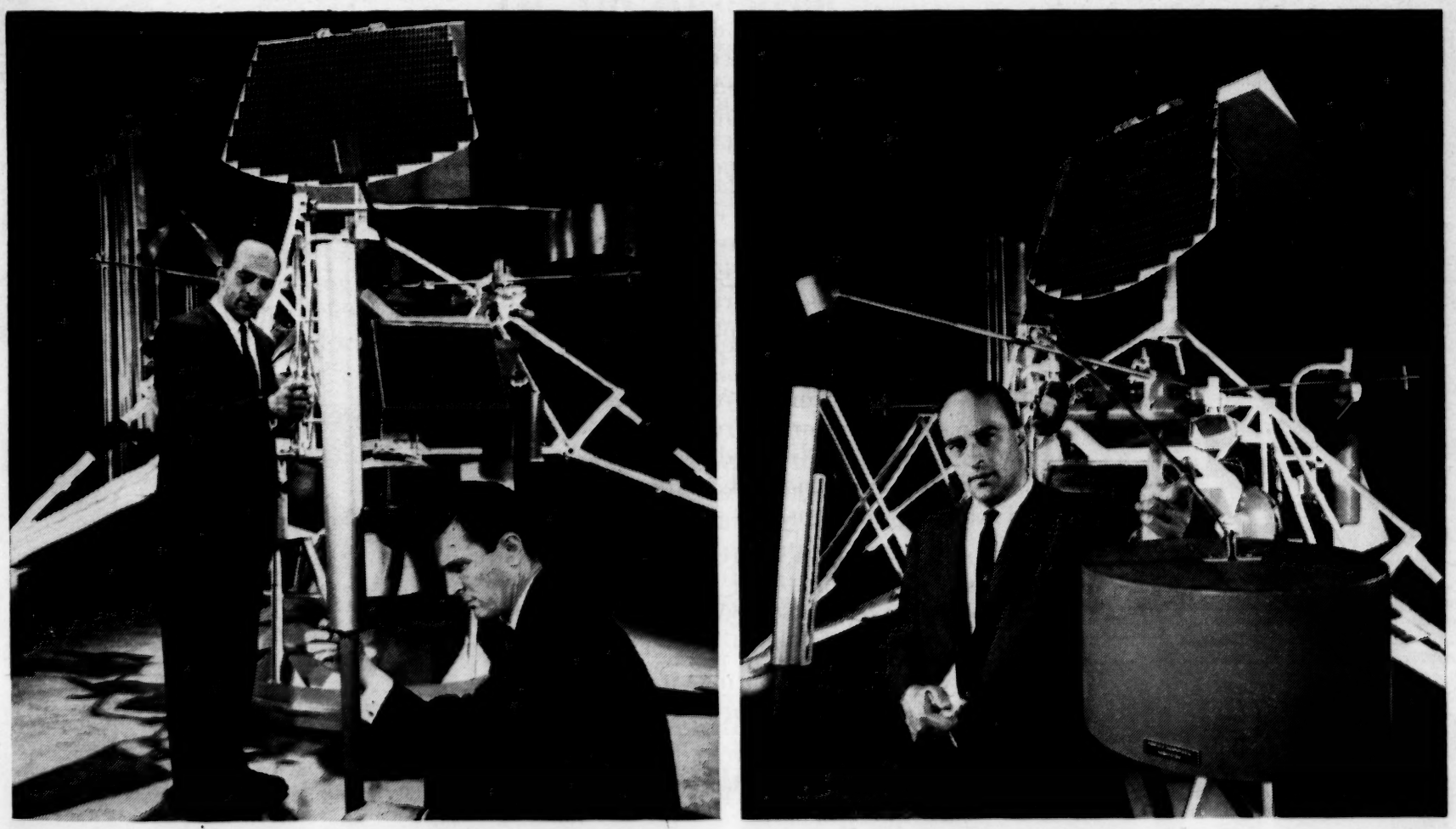
If the Surveyor structure were to topple over on its side during the landing, JPL and Hughes space technologists estimate that it might still be possible to obtain and telemeter some data by transmitting from the command receiver antennas.

In designing the vehicle itself, JPL, as program technical director for NASA, has specified that Hughes must plan to hit a target on the moon within a circular error of 50 mi. or less. The targets chosen for the Surveyor missions will be in the larger maria because of their comparatively level surfaces. One well placed source reports that the target of the first mission is likely to be in the Mare Imbrium.

The tripod structure of Surveyor will have high flotation feet on each of its three legs. Each foot will have a helium pressure jet for orientation of the vehicle during its coasting flight after separation from the Centaur launch vehicle second stage. Orientation system will use a doppler radar system as a sensor which will also act as a radio altimeter on which to base the sequence of events in the slow-down phase of the flight. The orientation system must have Surveyor set up on a lunar-centered vertical before the main retrorocket is scheduled to fire at an altitude of approximately 50 mi.

During the coasting phase before retrorocket ignition, Surveyor will have a mass (weight at sea level on earth) of about 2,500 lb. The main retrorocket is to be a large spherical solid propellant motor mounted in the center of the tripod, developing about 8,000 or 10,000 lb. thrust over a burning time long enough to decelerate Surveyor from a velocity of 9,000 fps. to near zero with respect to the moon. After burnout the expended motor case would be jettisoned downward by the detonation of its explosive mounting bolts to bring the vehicle down to its landing weight. Three liquid bipropellant vernier rockets developing a maximum thrust of perhaps 50 lb. each will be used to control the final descent velocity. Two will be fixed and one will be gimbaled to assist the helium jets in maintaining the proper orientation at landing.

The Surveyor tripod is designed with a wide base to reduce the likelihood of its toppling on landing. Each leg is to have a liquid spring shock absorber. Before the shock absorbers bottom, a crushable structure of metal honeycomb or balsa would be in contact with the lunar surface to absorb any remaining



SCIENTISTS operate mockup of Surveyor payload. Model was displayed for first time at CalTech's Jet Propulsion Laboratory, Pasadena, Calif. Closeup at left shows JPL Surveyor Project Manager W. E. Giberson holding tip of probe designed to measure moon's surface traits. Dr. L. Stoolman of Hughes holds boom extended from full scale model at right.

North American Aviation's Missile Division is now the Space & Information Systems Division

This is the Division that developed and is producing America's first successful air-launched strategic guided missile—SAC's GAM-77 Hound Dog—and brought it from drawing board to powered flight in just 21 months.

This is the Division that laid the foundation for a large part of America's current missile/space technology. Many of today's breakthroughs in aerodynamics, high speed flight, inertial guidance, large rocket boosters, materials, and manufacturing methods and equipment stem from original development work done by the Division.

This is the Division where the scientists of the Aero-Space Laboratories are seeking the keys to satellite rendezvous, refined trajectory analyses, space environment knowledge, lunar morphology, and materials to withstand space conditions.

This is the Division where intensive studies are underway on manned and unmanned space exploration vehicles, anti-ICBM projects, and information processing systems.

This Division is contributing vitally to America's rapidly developing space programs.

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SPACE & INFORMATION SYSTEMS DIVISION

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kinetic energy. Shock load conducted to instruments is expected to be no more than that experienced by a parachutist landing on the earth.

Hughes engineers are not worried about the prospect of interference with experiments by dust raised at impact. Laboratory experience on earth indicates that dust tends to be highly impacted in a vacuum.

Command Decoder Accepted by CalTech

Dallas, Tex.—First command decoder for Ranger lunar probes has been accepted by California Institute of Technology's Jet Propulsion Laboratory. The 1.7-lb. decoder, made by Texas Instruments' Apparatus Division here, will be carried in Ranger RA-3, RA-4 and RA-5, to accept and execute eight different "real-time" and six different stored commands for the purpose of controlling the National Aeronautics and Space Administration lunar probe's navigation, telemetry, altimeter power, vehicle midcourse and terminal guidance.

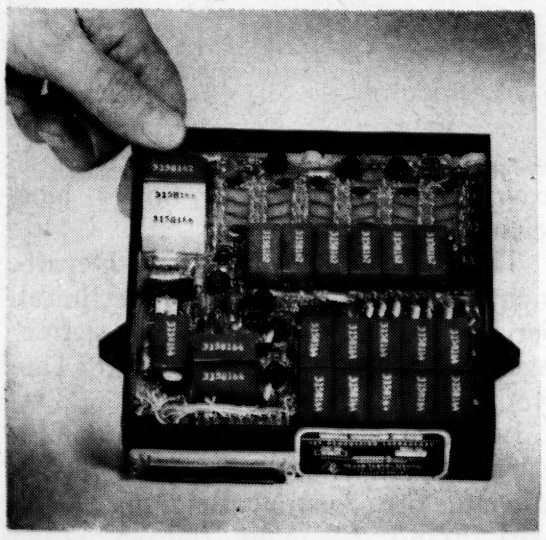
In operation the TI decoder will receive a demodulated signal from the Ranger's receiver, which obtained it from the ground in analog form. A synchronization pulse is used as a timing pulse in the decoding system to ensure that the airborne detector is in phaselock with the ground transmitter; a command "word" input, containing the necessary information for performing particular commands, is processed by the decoder, interrogated and sent to the proper circuitry for performing function desired; a dump signal is incorporated to indicate loss of tracking of ground command, to prevent erroneous commands from being given by the decoder due to interruptions in ground signal.

Decoder is designed to receive 18 bits to form a command word: first is a framing bit, which is deleted; next five bits are in an address block, which determines whether the command will be in real-time or as a stored order to be used later—the stored commands use all 17 bits, which are fed to a computer.

The decoder measures approximately 43 cu. in. and operates on one-half watt average power. Entirely transistorized, it uses modular construction for key circuitry such as multi-vibrators, shift registers and relay drivers. Modules are color-coded and may be interchangeable according to their color class. Each module contains about 16 miniaturized components sandwiched between circuit boards and potted in an epoxy compound to take severe environment.

TI engineers note that with this technique they achieved a component density of 100,000 parts per cubic foot in the average module, with the entire unit capable of withstanding storage temperatures up to 125C for at least 24 hr.

A completely transistorized decoder checkout equipment has also been delivered. This equipment provides 100% checkout of the airborne decoder by generating a simulated "word" and then studying the processing and execution of desired commands. If an error occurs, the checkout unit flashes a light and stops the test cycle. The cause of the error can be traced visually by comparing lights representing the received word with the preselected transmitted test word.



COMMAND DECODER for NASA Ranger lunar probe utilizes modular makeup.

Dynamic Analyzer To Aid Research

A dynamic analyzer, designed to simulate flight conditions from sea level to orbital altitude, will permit laboratory study of reconnaissance equipment as affected by the buffeting, vibration, pitch, yaw and roll of various aerospace vehicles.

Prime contractor for the analyzer, which is being installed at Wright Patterson AFB, Ohio, is Minneapolis-Honeywell. Minneapolis-Honeywell also is responsible for the design and fabrication of a mobile target cart and for the control systems.

Vacuum conditions of the analyzer's capsule unit will range from sea level to 3.8 x 10^7 mm. at Hg in 100 min. with temperature conditions ranging from ambient to 450F in 45 min. The unit will also be capable of sustaining combined temperatures, one-half at 400F, the other half at −40F.

Design and fabrication of the capsule is by Cooke Electric Co. Universal Match Co. will provide the hydraulic roll, yaw and pitch mechanism to simulate flight conditions. Installation of the testing equipment in an existing building has been contracted to Burns & Roe, engineers and constructors, and in-

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cludes the 40,000-lb. dynamic analyzer capsule, approximately 8 ft. in diameter and 10 ft. long.

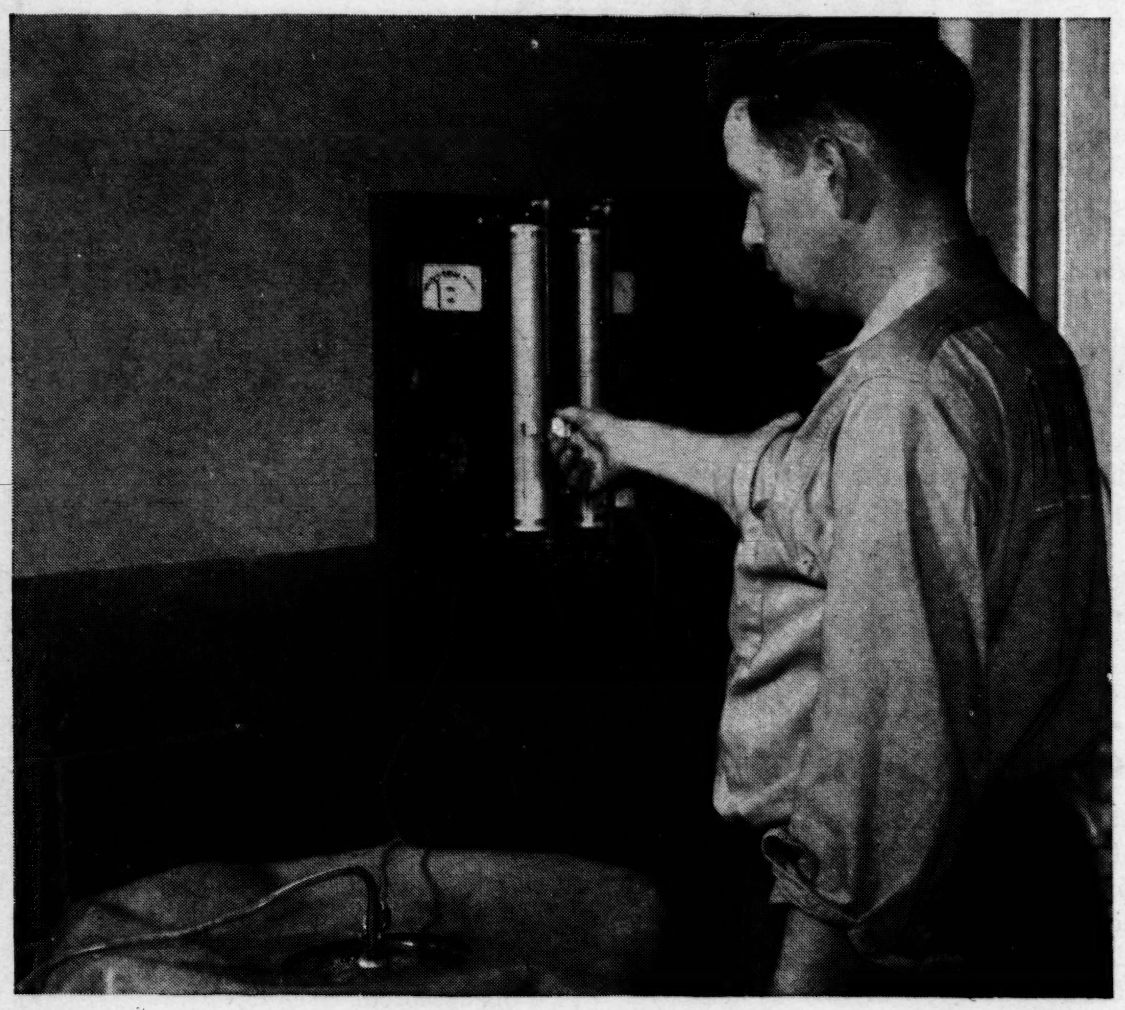
A study by Burns & Roe considers the effects of capsule movements, notably vibration, on the foundation of the associated mobile target cart. The vibration forces must be completely isolated to assure optimum stability of the cart. Acoustic shielding will be provided the cart to isolate sound wave transmission to its sensitive mechanism. Two sensing windows of high optical quality with an 18-in. diameter free area are provided for target cart viewing.

An infrared target and ground speed simulator will permit performance evaluations of various infrared devices located in the capsule.

The simulator, to be located beneath the capsule of the analyzer, will be mobile for purposes of interchange with the photographic and television target and the ground speed simulator cart. The portable cart, approximately 8 ft. wide and 24 ft. long, will house the collimator, infrared targets and associated equipment. The control room will be the centralized control point for the operation of the analyzer and the equipment under test as well as the point of all data recording. A flight program and analyzer control area will contain all the essential controls and recording devices for the operation and monitoring of the analyzer. A test item control area will control the various recording and other instrumentation devices for the operation and monitoring of the equipment being tested.

Because of ultra high vacuum problems, test samples will be thoroughly cleaned and sterilized. To keep them free from dust or other contaminants during transfer from the sterile room to the dynamic analyzer, Burns & Roe is designing a mobile plastic sleeve to transport the specimens.

Other responsibilities of Burns & Roe include the design, engineering and installation of foundations, supports, platforms, piping and electrical conduit layouts; the coordination of all design efforts in order to compile a construction drawing package with the specifications; and construction and supervision of the entire effort which encompasses shop and as-built drawings.



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Aerobee Launch Relays Telemetry

Washington—Schedule of about one flight a month is being planned to assess behavior of liquid hydrogen in a zero gravity following launch of the first Aerobee 150 rocket in the series Feb. 5 from Wallops Island.

The first liquid hydrogen flight (AW Jan. 16, p. 28) produced telemetry data, but a recovery package containing a movie camera could not be retrieved because of heavy seas. The camera pack, which is designed to float indefinitely, landed about 50 mi. from the Wallops launch site. A helicopter was stationed about 40 mi. away for a midair snatch attempt, but it was not successful.

The single-stage Aerobee launch vehicle carried the 303-lb. payload to an altitude of about 94 mi. The test series is being conducted by National Aeronautics and Space Administration's Lewis Research Center.

Soviet Space Data To Be Correlated

Washington—U.S., Canada and 12 European nations have established a cooperative program to catalogue and exchange translations of Soviet bloc scientific information.

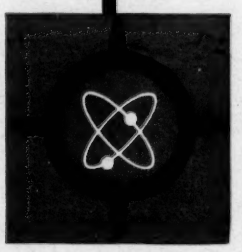
The project links the U.S. Department of Commerce Office of Technical Services and the European Translation Agency, which is located in Delft, The Netherlands.

In addition to The Netherlands, European countries participating in the program are Austria, Belgium, Denmark, France, Germany, Italy, Norway, Spain, Sweden, Switzerland and the United Kingdom.

RYAN'S VITAL ROLE IN THE AGE OF SPACE

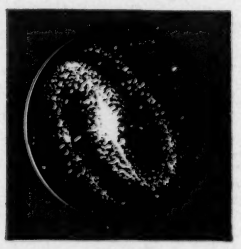
There's a new look at Ryan—the look of a company that has pioneered in the aircraft and missile eras and is now geared for the challenging demands of the Space Age. Fast-moving, flexible, staffed with men skilled in solving problems *beyond the usual*—Ryan's two divisions and three subsidiaries complement each other in achieving breakthroughs in the new technologies of the Space Age. From Doppler navigation systems to multi-stage space probes to fresh concepts in data handling and electronic communications—Ryan continues to demonstrate its capabilities in the most advanced fields of design, development and fabrication. *New contracts, calling for years of design and development work, have created many job opportunities at Ryan for career engineers with abilities beyond the usual.*

RYAN ELECTRONICS



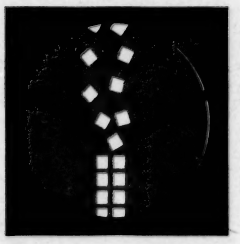
A division of Ryan Aeronautical Company, Ryan Electronics develops and manufactures electronic systems for aircraft, missiles, ships, and space systems. With plants at Kearny Mesa, San Diego (Engineering Center) and Torrance, Calif. (Production Center), Ryan Electronics is recognized as the world leader in C-W Doppler navigation. The Division's programs are making significant contributions toward solution of lunar landings, terminal guidance, gravitation control, and ECM.

RYAN AEROLAB



Aerolab Development Company, located at Pasadena, California, is a subsidiary of Ryan Aeronautical Company. Aerolab has developed more space probes and rocket-powered research models, including the Mercury Capsule model, which have been fired, than any other firm in the United States. Aerolab is a science team with quick reaction capabilities, and with special talents for solving advanced problems in Space.

RYAN TRANSDATA

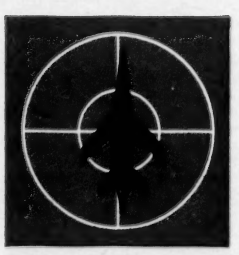


A subsidiary of Ryan Aeronautical Company, Ryan Transdata, Inc. (San Diego) is developing methods for the automatic conversion of information to a form that will enable industrial and government executives and military commanders to make rapid, accurate decisions. Related applications include air traffic control, military command control and surveillance logistics control, and command control of space vehicles.

RYAN COMMUNICATIONS

Ryan Communications, Inc., a subsidiary of Ryan Aeronautical Company, is located at Canoga Park, California. Under development here are solutions to specialized communications problems of the military, government and industry. Fields include high-, very high-, and ultra-high frequency and microwave transmitting and receiving equipment, methods of coding modulation and multiplexing, and space-aided communications.

RYAN SAN DIEGO



As an experienced systems manager, Ryan San Diego can integrate and focus the special capabilities of all company units on the problems of missiles, drones and space vehicles. Ryan's rich background as a pioneer in the development of systems, such as the most widely used jet-powered, recoverable drone and the first jet VTOL research aircraft, extends over three decades. Long before the Space Age dawned, Ryan was developing capabilities to meet its challenge.

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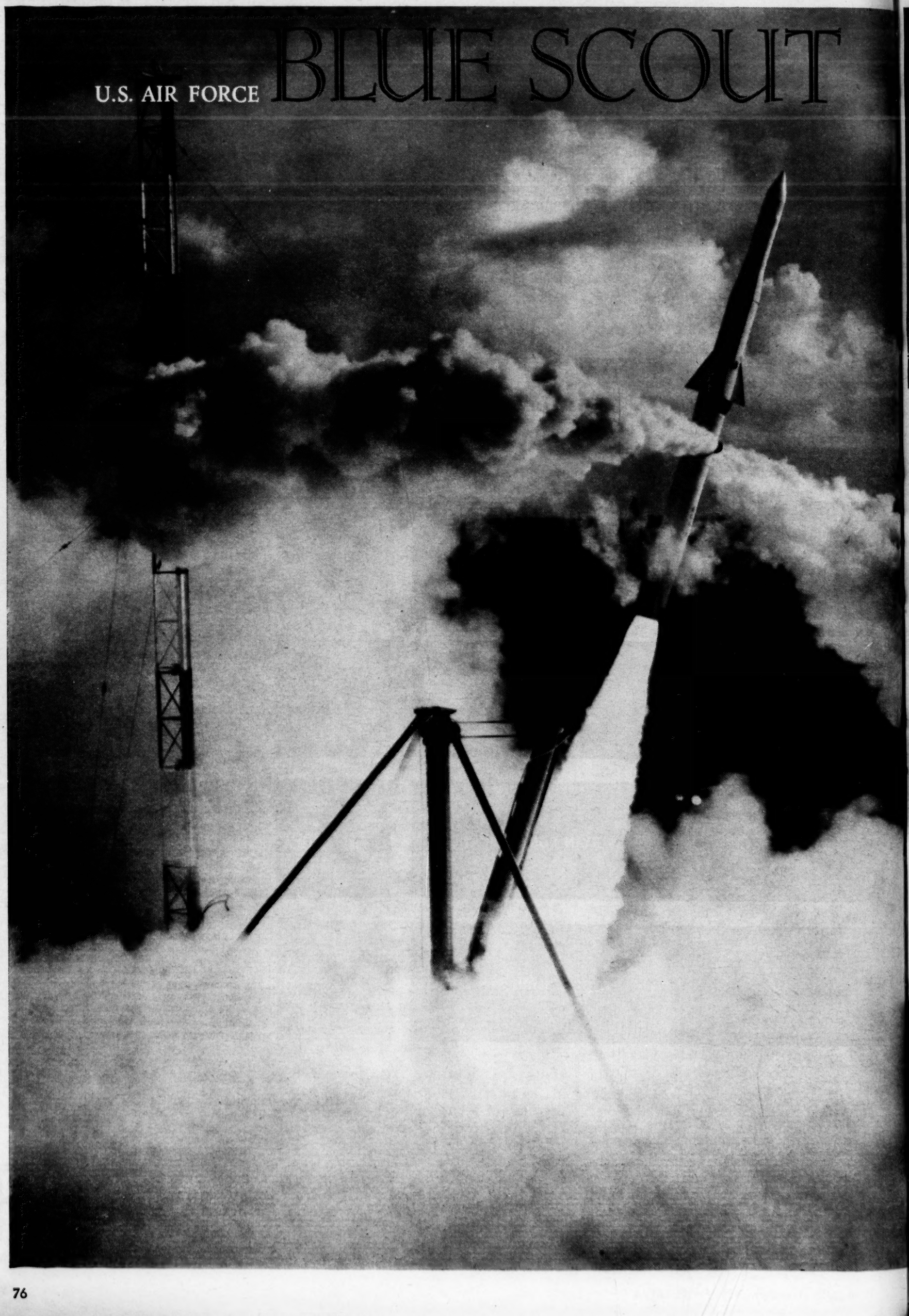
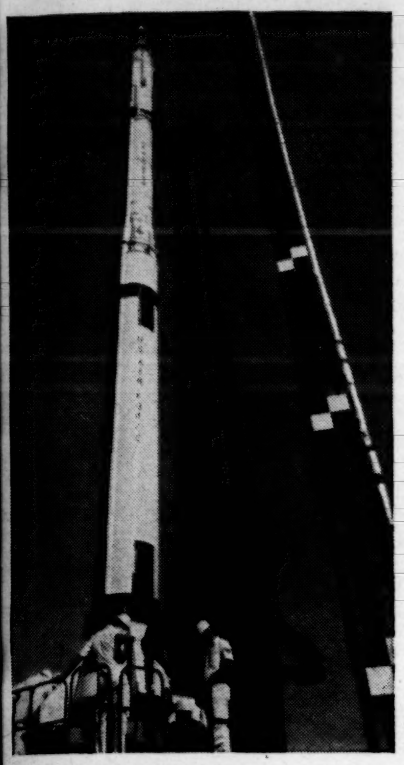
U.S. AIR FORCE

BLUE SCOUT





LEFT: USAF technicians of 6555th Test Wing under technical supervision of Aeronutronic engineers erect Blue Scout on simplified launch pad prior to successful flight. The development of Blue Scout effectively bridges gap between larger, more expensive ICBM's and smaller sounding rockets in our advanced space research and test programs. The Blue Scout is the largest solid fuel missile ever fired at Cape Canaveral.

OPPOSITE: U. S. Air Force Blue Scout Jr., lifts off launch pad as spin rockets ignite. This unguided 4-stage missile was successfully launched on the first attempt.

U.S. AIR FORCE PHOTOS

The United States Air Force Blue Scout Program provides the Nation with a new and versatile low-cost family of test vehicles to support our military weapons and space systems development programs. It can be used in a variety of deep space probes, orbit missions, boost glide trajectories, and as a rocket and satellite command and control communications system. Blue Scout has already fired a 32-pound scientific payload 16,000 miles into space ...and a 392-pound payload in a controlled trajectory 1400 miles down the Atlantic Missile Range. Aeronutronic is systems engineer, payload and test contractor on this important Air Force program.

AERONUTRONIC DIVISION *Ford Motor Company*, DEFENSE PRODUCTS GROUP
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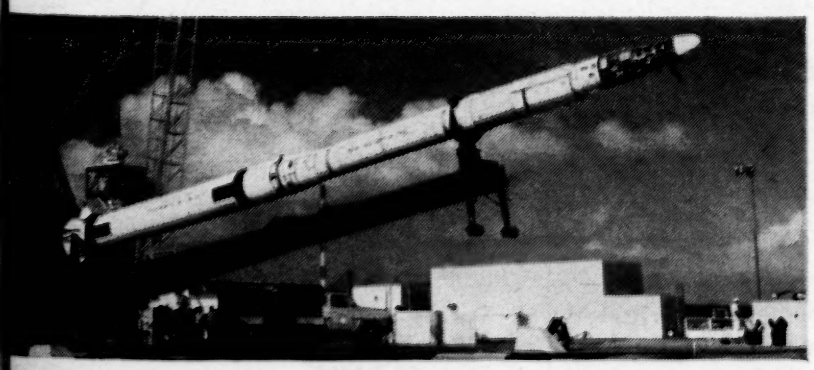

Write for information about Aeronutronic's capabilities and the career opportunities open for engineers and scientists.

The Blue Scout program, based on modifications of the NASA Scout, is under the executive direction of the U.S. Air Force Ballistic Missile Division, Air Research and Development Command. Above LEFT: Blue Scout is raised to a firing position on simplified launch pad. Because missile requires minimum ground support equipment, it is operable in a number of various field environments at minimum cost. *RIGHT:* Instrument package of Blue Scout is checked by Aeronutronic personnel and Air Force technicians. Accurate guidance system, data recovery system and final stage attitude control make Blue Scout adaptable to a wide variety of applications.

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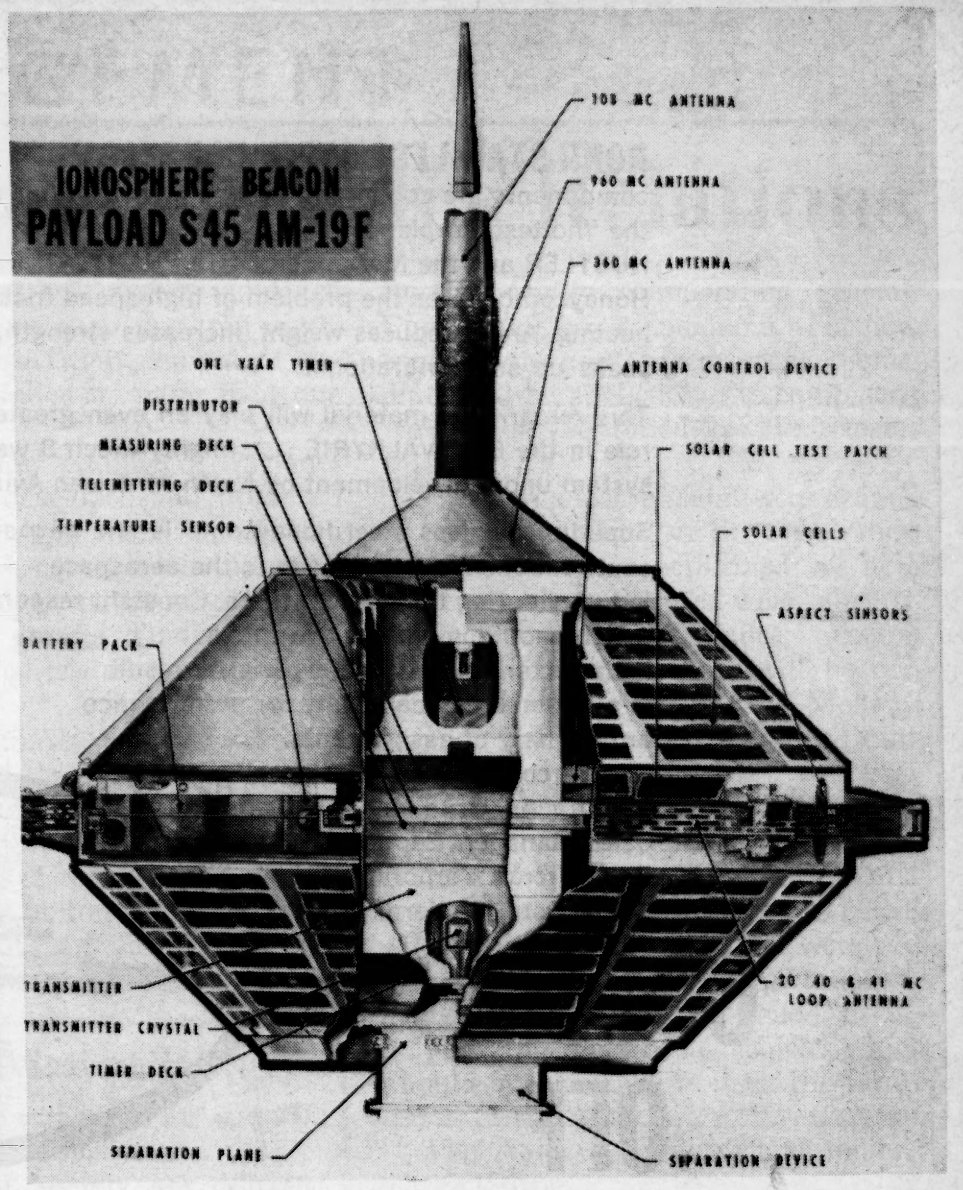
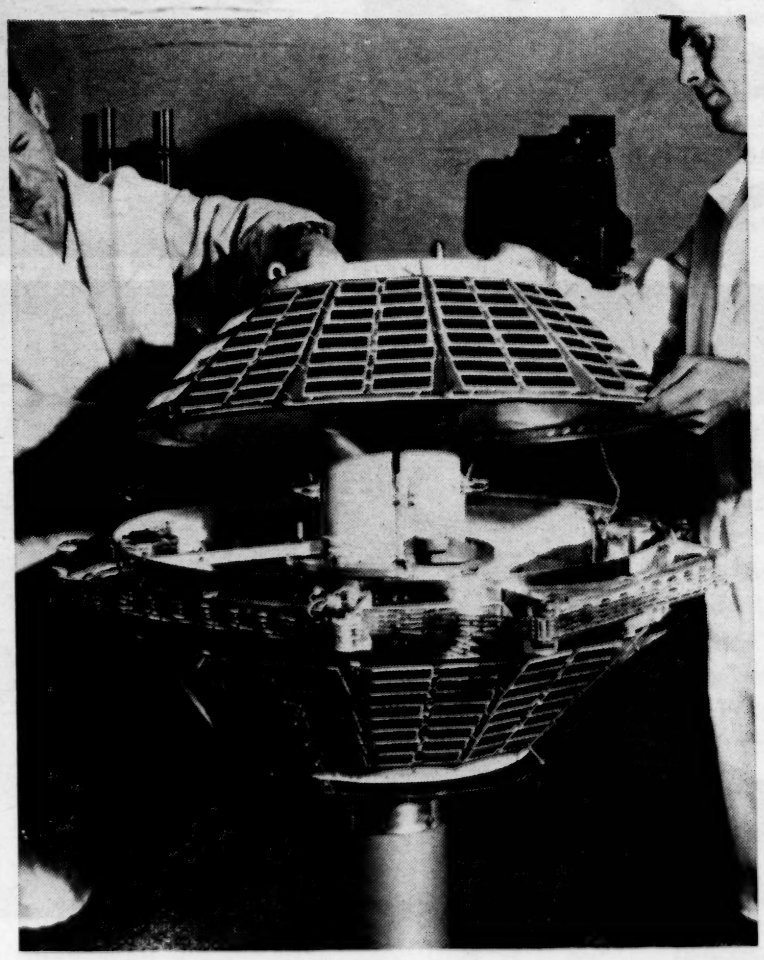
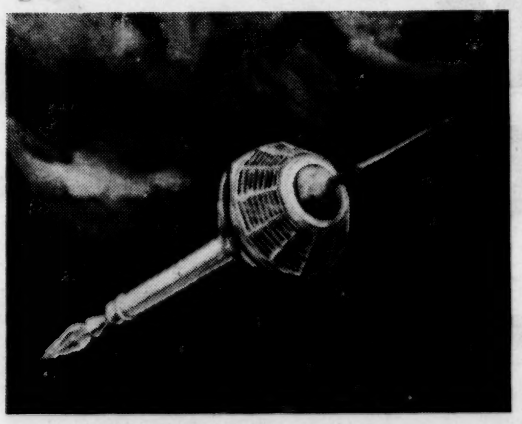


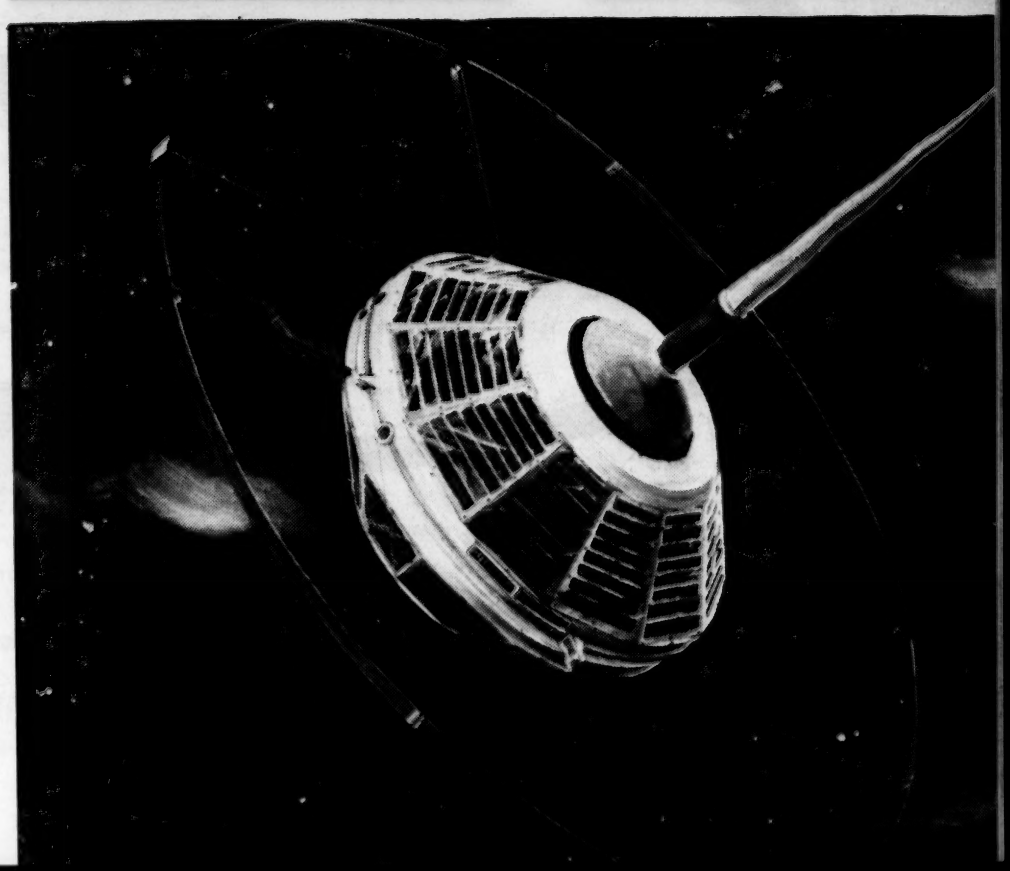
Technicians are shown examining S-45 Ionosphere Beacon Satellite payload. Cutaway (right) details major satellite components.

Juno II S-45 Payload Prepares to Measure Ionosphere



S-45 will be attached to fourth stage of Juno II which will launch Beacon payload into 240-mi. perigee and 1,650-mi. apogee. Mission of the S-45 is to measure ion and electron concentrations in its orbital path.





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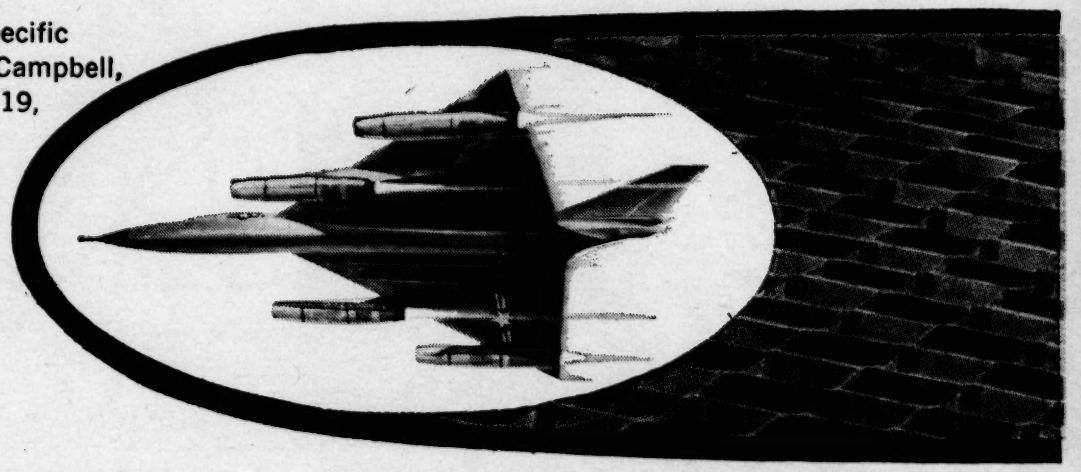
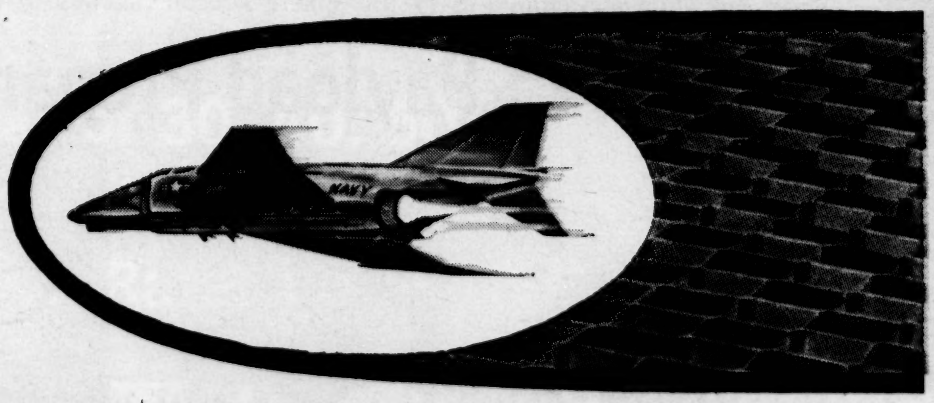
components are cooling off critical points on two of the "hottest" airplanes flying . . . Convair's B-58 HUSTLER and the McDonnell F4H2 PHANTOM. Honeycomb solves the problem of high-speed friction heating. And it reduces weight, increases strength, soaks up sonic vibrations.

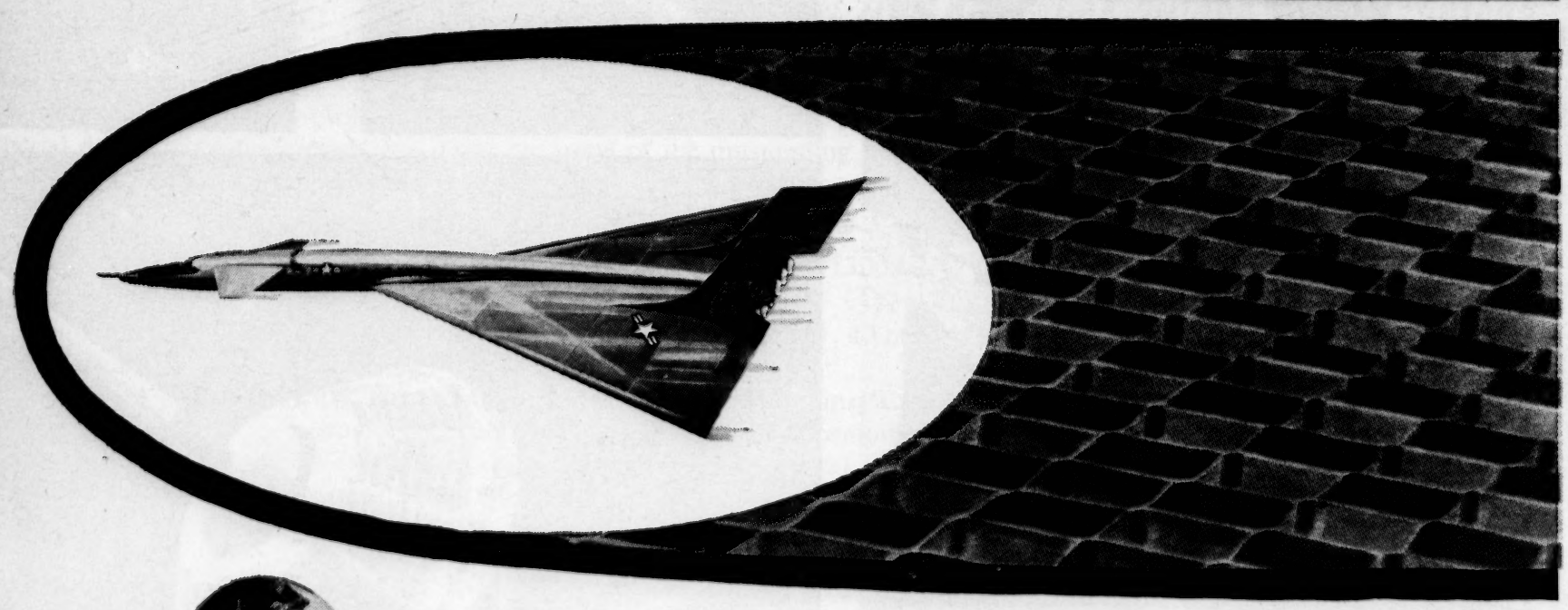
This remarkable material will play an even greater role in the B-70 VALKYRIE . . . mighty mach 3 weapon system under development by North American Aviation.

Superior stainless steel honeycomb is one of many contributions Rohr has made to the aerospace industry during the past 20 years. Constant research, enlightened engineering, inventive manufacturing, and rich experience result in an unmatched capability for performance on a variety of assignments.
For the complete story or specific information, write Mr. A. R. Campbell, Sales Manager, Department 19, Rohr Aircraft Corporation, Chula Vista, California.

COOLING OFF THE HOT ONES







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Army Expands Direct Industry Relations

By Larry Booda

Washington—First direct Army engineering and procurement of aircraft and major components, authorized last July, is being implemented under recently approved procedures, and the Army hopes to further expand these direct relations with contractors.

This action paves the way for the first development of in-house capability in aviation procurement and engineering areas since aircraft were first authorized for direct use by Army ground forces in 1942. Currently, the Army must direct the design and procurement of all aircraft and major components through the Air Force or Navy.

Expansion of Army activity in these areas will permit development of a group of personnel that is technically competent and practiced in working directly with contractors. Building on this core of trained personnel, the Army hopes eventually to become independent of the other services in designing, engineering and buying its aircraft and aviation equipment.

Although the Army ground forces have been flying their own aircraft since 1942, they had to handle all technical and procurement matters through the Army Air Force and later the Air Force. In 1956, the Army was permitted to handle these functions through the Navy as well, and in 1957, an agreement was reached to permit the Army to buy a limited number of minor aviation items directly.

Expansion Authorized

Last July, the Secretary of Defense authorized a major expansion of direct Army relations with its contractors, including:

- **Direct procurement** from industry of off-the-shelf items. Off-the-shelf is defined as aircraft and components which have been certificated airworthy by the Federal Aviation Agency.
- **Preparation of specifications** for Army aircraft and components in coordination with the Air Force and the Navy.
- **Establishment** and conduct of boards of inspection.
- **Active participation** through assignment of Army personnel with the developing and procuring agency for "other than off-the-shelf" Army aviation equipment.

Although there have been procedures in existence for interservice action in engineering and procurement of Army equipment, the recent implementation marks a major step by having a coded single document available for guidance of all three services. It does not apply to joint-service aviation equipment developed and funded by more than one service.

Army aviation equipment includes aircraft being developed and produced for inventory, along with their related accessories and concurrently procured components, repair parts, special maintenance tools, ground handling equipment and special related training equipment.

Certain electronic equipment normally supplied by the Army Signal Corps is excluded.

Composition of Army aviation for the next 10 years has been determined through studies performed by the Army Requirements Review Board, or Rogers Board, headed by Lt. Gen. Gordon B. Rogers, deputy commanding general, Continental Army Command. The new engineering and procurement procedures will be applied to the equipment requirements outlined by the Rogers Board.

Three principal missions were defined by the board. First is the observation mission, currently performed by helicopters and small fixed-wing aircraft. Second is the surveillance mission, which in the near future will be performed by the Grumman AO-1 Mohawk using of side looking radar. Third category is transport.

These missions took the form of Army Study Requirements (ASRs). ASR 60-1 covers the observation mission; ASR 60-2, surveillance, and ASR 60-3, transport. These ASRs were presented to industry as an invitation to participate in studies designed to determine the types of air vehicles which should be developed to meet the future needs of the Army.

The ASRs do not include military characteristics.

Technical Possibilities

Response to these ASRs produced a complete picture of technical possibilities based on the current state-of-the-art. On this foundation, the Army is preparing military characteristics on which to base design competitions.

After study by working groups which used the services of the Langley Research Center of National Aeronautics and Space Administration and the Army's Transportation Research Command, the Rogers Board determined that the three main areas which will be covered in the future are:

- **Observation.** A new helicopter will be needed to replace the H-13 and H-23 helicopters and the L-19 fixed-wing aircraft. This has already resulted in a design competition for a light observation helicoper (LOH).
- **Surveillance.** A new STOL aircraft with increased capabilities, incorporating the latest electronics equipment, will be required.
- **Transport.** A VTOL aircraft, which could be an unloaded rotor convertiplane, a tilt-wing aircraft or the product of the current tri-service VTOL program, which will be funded for $18 million in Fiscal 1962.

Engineering and procurement for Army aviation involves coordination between five organizations within the service.

Principally involved is the Chief of Transportation, whose deputy, Maj.

Army Aviation History

1942—Aircraft authorized for operation by Army ground forces.

1947—National Security Act delineates departmental missions and functions in support of Army aviation. Air Force retained procurement, development, storage, issue and maintenance functions.

1949—Army assumed responsibility for field maintenance and supply distribution below depot level.

1954—Joint Army-Air Force team began to study supply and maintenance problems and to recommend changes in existing agreements.

1955—Secretary of Defense approved transfer of depot support of Army aircraft from Air Force to Army, phased over the 1956-1959 period.

1956—Army first assumed responsibility for depot support.

1956—Secretary of Defense authorized Army to procure aircraft through Navy as well as Air Force.

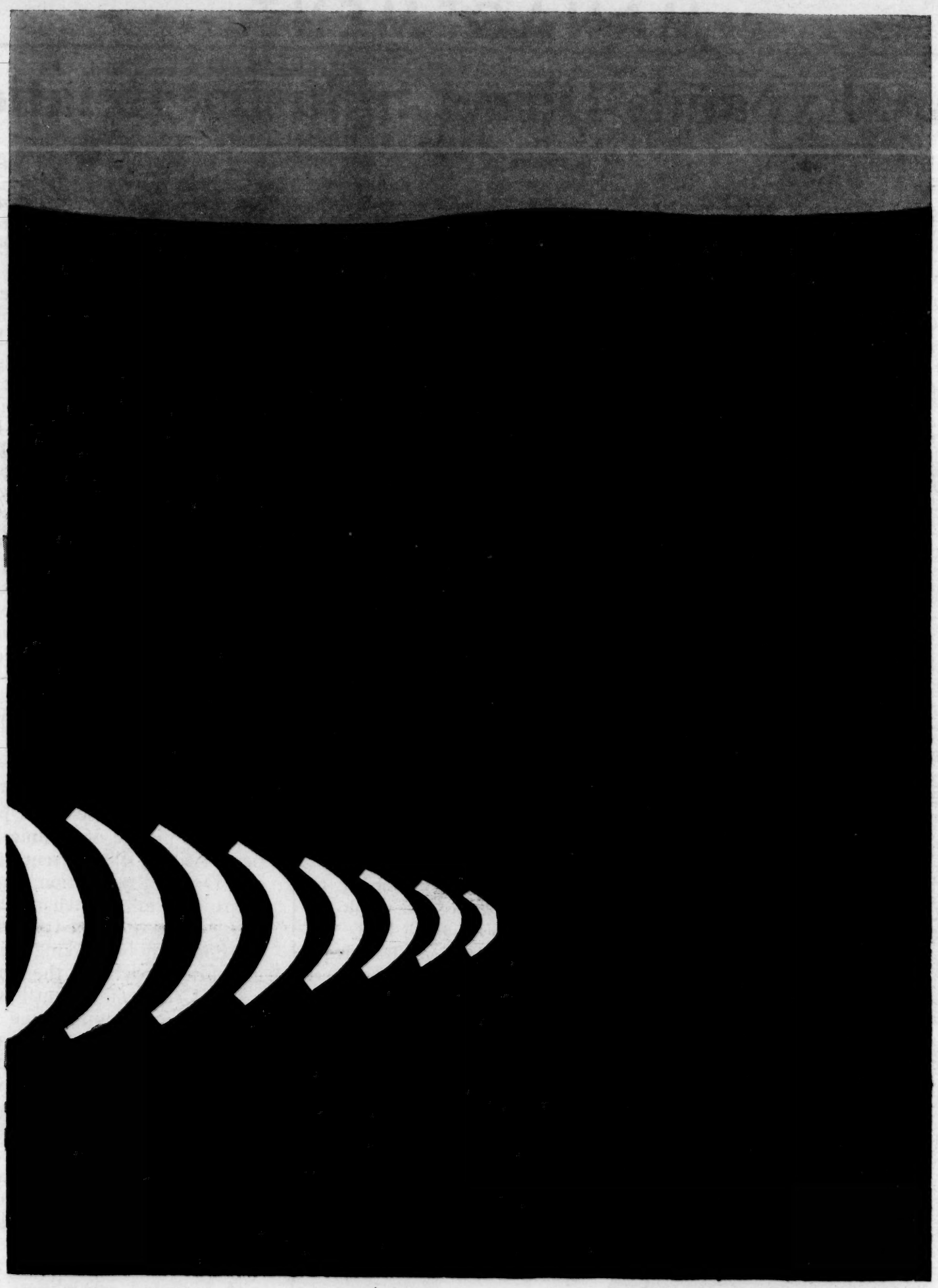
1957—Army Aircraft Maintenance Shops opened in four General Depots—ahead of schedule.

1957—Air Force and Navy agree to Army procurement of limited secondary items.

1958—Transfer of depot stocks from Air Force was completed, ahead of schedule.

1958—Contracting for depot maintenance at contractors' plants transferred from Air Force.

1960—Secretary of Defense granted the Army authority to engineer and procure certain aircraft and comproponents directly from industry.



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Gen. Richard D. Meyer, is a rated pilot. It is from his office that procurement coordination is achieved.

For avionics installations, the Signal Corps has cognizance. Ordnance Corps provides the weapons, while the Quartermaster Corps furnishes fuel and oil. In a small degree, the Chemical Corps is involved in instances where chemical, bacteriological and radiological warfare is concerned.

Guidance to these staff level organizations comes from the Continental Army Command, whose Aviation School at Ft. Rucker, Ala., determines materiel doctrine and combat doctrine. Clearinghouse for these doctrines is the office of Brig. Gen. Clifton F. Von Kann, director of Army aviation under the deputy chief of staff, operations.

Within the chief of transportation office, there is an executive for programs under whom there is a Systems Management Division. Each program, such as the HU-1, AC-1 and AO-1 aircraft, has a management group which in each case acts as a system manager.

The system manager is responsible for monitoring a program so that procurement coordination is accomplished at staff level. Also under the chief of transportation is a research and development office responsible for liaison with the Transportation Research Command at Ft. Eustis, Va. Trecom, the Army equivalent of the Office of Naval Research, works with the research offices of the other services, with Air Research and Development Command and Transportation Materiel Command.

TMC Authority

It is the Transportation Materiel Command that has direct cognizance over the full cycle from development to procurement. It is the equivalent of the Air Force Air Materiel Command plus part of ARDC, and of the Bureau of Naval Weapons. Located at St. Louis, Mo., TMC is divided into two principal parts—engineering and development and procurement. TMC has two means of doing business—either by working through the other services or by dealing directly with a contractor.

During the current transition period, TMC maintains liaison teams at the Bureau of Weapons and at the Air Materiel Command. At Bureau of Weapons, for instance, there is a permanent group of seven persons under a colonel who monitor fiscal and budgetary matters. When the occasion demands, a group of about 15 officers and civilians joins the Bureau of Weapons to perform technical evaluations on a specific program for a period of about three months.

When TMC initiates a procurement program, it is done by means of a Military Interdepartmental Procurement Request (MIPR). This request applies to other-than-off-the-shelf (Otofs) items.

In the past, direct work with contractors has been in relation to off-the-shelf items and secondary air items. Under the new order, direct contact with contractors has begun in relation to other production and development. This is the "go ahead and buy" aspect which marks a new departure.

By placing task forces, such as the groups at Bureau of Weapons, with other services, Army is augmenting its management capability. Test and evaluation of complete aircraft systems is conducted at Ft. Rucker.

Engineering Cooperation

However, when the Air Force or the Navy has cognizance of a specific program, engineering test work is done under the responsible service. Army pilots are being assigned to other service commands to participate in this work. Ten are currently undergoing training at the Air Force test pilot school at Edwards AFB, Calif.

There are four boards for which the Army provides chairmen when the other services are charged with a program (see box). The boards involved are the Development Model Specification Review Board, the Mockup Board, the Developmental Contract Compliance Board and the Production Contract Compliance Board.

In the reviews conducted by these boards, a majority vote will decide all matters, and in the case of a tie, the chairman casts the deciding vote. Boards are composed of three members from the Army in addition to the chairman, and three members from the developing or producing service. Thus the Army retains final decision power. In practice, disagreements and close votes are reportedly rare.

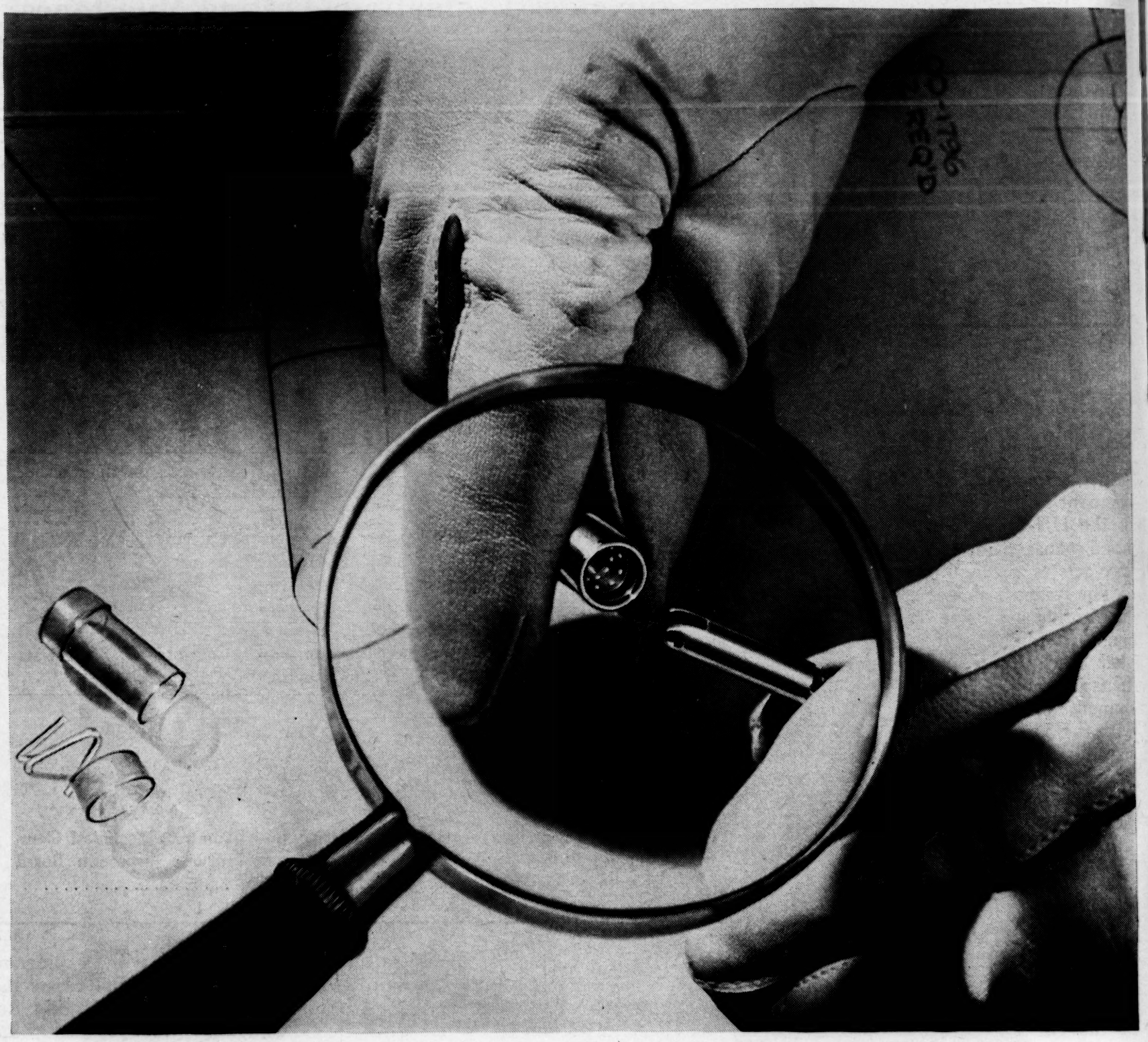
Board recommendations do not constitute authority for action which involves changes that alter the basic characteristics of the equipment, impose significant new requirements or materially affect cost or delivery schedules.

Recommendations in this category must be reviewed by the Army for adjustments in funding or programing. For routine changes, the boards ap-

Equivalent Evaluation, Testing Milestones

	Army	Navy	Air Force
1.	Requirements Review Board	Deputy Chief Naval Oper. (Air)	Air Council
2.	Evaluation Board for Design competition or source selection	Design evaluation—Evaluation Div. Bureau of Weapons	Design competition—Source Selection Board
3.	Development Model Specification Review Board	Detail Specification—Aircraft Design Office, Bureau of Weapons	Model Specification Review Board
4.	Mockup Board Engineering Acceptance Board Maintenance Engineering Board Development Contracts Compliance Board	Mockup Board Monitored by Bureau of Weapons Rep. and Aircraft Design Office, Bureau of Weapons	Mockup Board Engineering Acceptance Inspection Board Maintenance Engineering Inspection Board Contract Technical Compliance Inspection Board
5.	Engineering testing	Contractors demonstration, Navy Preliminary Evaluation (NPE), Board of Inspection and Survey (BTS), Trials	Category I and II flight tests
	Army service, logistical and troop test	Fleet Indoctrination Program (FIP) or Replacement Carrier Air Group (RCAG)	Category III flight tests
6.	Production Model Specification Review Board Production Contract Compliance Board Confirmatory Testing	Detail Specification—Design Office, Bureau of Weapons Aircraft Design Office, Bureau of Weapons	Model Specification Review Board Contract Technical Compliance Inspection Board .....

NEW DEPARTURES IN MINIATURE



HOW TO GIVE ON-THE-NOSE GUIDANCE TO MODERN "FISH"

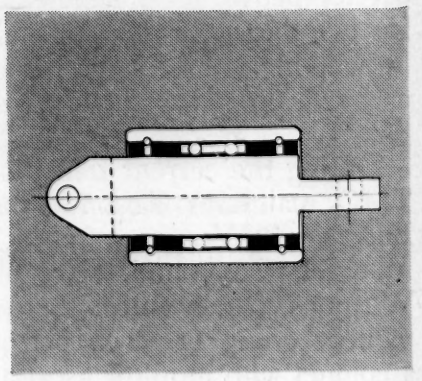
UNIQUE N/D LINEAR MOTION BEARING FREES GYRO CAGING ACTION

The bearing illustrated is an N/D linear motion precision instrument ball bearing. It was specially designed and built to help solve a critical problem in the guidance system of a high speed anti-submarine torpedo.

PROBLEM: Loss of accuracy in torpedo's guidance system due to hang-up of caging arm in gyro assembly.

SOLUTION: N/D Sales Engineer, in cooperation with manufacturer, found that *wear* of bushing on caging arm caused hang-up, delaying guidance activation. N/D Engineers set to work to design and build an instrument bearing that operates virtually friction-free. The result: Preservation of the guidance system's pin-point accuracy and reliability.

Should you require ball bearing design information, invite the local N/D Sales Engineer to participate in your early design discussions. He represents one of the industry's largest engineering staffs devoted exclusively to the design and development of miniature and instrument ball bearings. Or, write for new Miniature and Instrument Ball Bearing Catalog, Department L.S., New Departure, Division of General Motors Corporation, Bristol, Connecticut.



This special N/D linear motion instrument ball bearing increased guidance reliability of ASTOR torpedo weapon system developed by Westinghouse.

NEW DEPARTURE

MINIATURE AND INSTRUMENT BALL BEARINGS

JetStars Make Transition From Assembly to Flight Tests

Lockheed JetStars are almost ready to be rolled out from company's Marietta, Ga., facility. Lockheed has received type inspection authorization from the Federal Aviation Agency for the aircraft. Structural test evaluations have been completed by the FAA, whose observers witnessed fatigue tests conducted on the aircraft at Lockheed's Engineering Laboratory.

prove or disapprove for the Army. Points of contact for procurement are:

- **Initiation of and inquiries** concerning MIPRs: U.S. Army Transportation Materiel Command, 12th and Spruce Streets, St. Louis, Mo., Attention: Director of Procurement, Production.
- **Specifications, Standardization** and Cataloging: Army Transportation Materiel Command, St. Louis, Attention: Director of Cataloging, Standardization.
- **Requirements:** Army Transportation Materiel Command, St. Louis, Attention: Director of Materiel Requirements.
- **Army Policy:** Department of the Army, Chief of Transportation, Washington 25, D. C., Attention: TCPCD.

Points of contact for development and engineering are:

- **Development and Engineering** of Army Aviation Equipment: U.S. Army Transportation Materiel Command, Box 209, Main Office, St. Louis 3, Mo., Attention: Director of Engineering.
- **Basic and Applied Research** applicable to Army aviation equipment: U.S. Army Transportation Research Command, Ft. Eustis, Va., Attention: Director of Aviation.
- **Policy and Procedure:** Department of the Army, Office Chief of Transportation, Washington 25, D. C., Attention: TCDRD.

British Aviation Exports Decline

London—British aviation exports last year totaled $398.4 million, a drop of $38.3 million from the previous year's record high, but engine sales reached a new peak of $206.3 million, topping the 1959 record of $180.6 million, the Society of British Aircraft Constructors said.

The 1960 over-all export figure was still the third highest yet recorded, compared with $463.8 million in 1959 and $431.2 in 1958, and brought the value of the industry's postwar exports to $3,035.2 million, the society said.

Last year the value of engine exports exceeded for the first time that of aircraft sales which accounted for $172.7 million.

Edward Bowyer, director and chief executive of the society, said it was gratifying that the 1960 figure came so near the 1959 record. He recalled that for five straight years, from 1955 to 1959, the industry has set new records, but that more than two years ago he had warned of a dip in export trade.

Although present evidence did not point to a spectacular rise in export trade in 1961, orders in hand for overseas customers last year exceeded those held in 1959 and deliveries during the next year would be "brisk" he added.

Value of business in hand in 1960 included $84 million for 35 airliners ordered by operators in the U. S., Canada, Egypt, Greece, Austria, Ghana, Japan, West Germany and The Lebanon.

Aerodynamics School Accepting Applicants

Training Center for Experimental Aerodynamics, Rhode-Saint-Genese, Belgium, is accepting applications for a one-year diploma course in experimental aerodynamics. The course runs from Oct. 2, 1961 to June 30, 1962.

The training center is an international educational institution, accepting its applicants from among the NATO nations, and is under the chairmanship of Prof. Theodore von Karman. It possesses wind tunnels in its laboratories near Brussels.

There are no fees for the course and several student fellowships are available to cover cost of living. Entry applications and additional information may be obtained from: The Director, Training Center for Experimental Aerodynamics, 72, Chaussee de Waterloo, Rhode-Saint-Genese, Belgium.

Remote unit reports progress
Located in the Sales Department, this remote inquiry station has a direct line to the RAMAC unit on the floor below. When a customer order number is keyed into this station, an up-to-date status report is *immediately* printed out on the automatic typewriter.

Keeps an eye on production
Final assembly and testing of these Cramer timing controls are typical of the many precision operations carried on in the plant. Each involves a large number of small parts which are produced, stocked and assembled under MOS control.

Gets information fast—Mr. J. T. Kennedy, Treasurer, checks with operator of the IBM RAMAC 305 Data Processing System—the heart of Cramer's Management Operating System. Disk file at rear stores and continually updates all operating records—each immediately available on demand.

Management Operating System at Cramer Controls Corporation

...improves delivery and reduces inventory ...with an increase in sales of 60%

Cramer Controls Corporation, Centerbrook, Connecticut, manufactures precision timers and control instruments. They consider their IBM Management Operating System a *highly profitable investment.*

To this progressive company, with 330 employees and annual sales of around $4 million, IBM data processing is an essential part of management control. It has helped them cut costs...reduce inventories... improve profit margins...speed customer service. And it has done all this while handling a 60 per cent increase in sales and reducing delivery time by five full days.

Built around the IBM RAMAC® 305, the system at Cramer uses modern data processing techniques to *inter-relate* the six major control functions: Sales Forecasting, Materials Planning, Inventory Management, Plant Scheduling, Work Dispatching & Operations Evaluation.

How MOS works to cut costs

Complete data for each major operating function is stored in your data processing system. There, past and present sales trends and forecasts are combined to produce a more complete "finished product" plan which automatically...

- determines material requirements
- checks these requirements against inventories
- allocates stocks to assembly needs
- polices inventories for under- or over-stocked items
- initiates stock-replenishing orders as needed

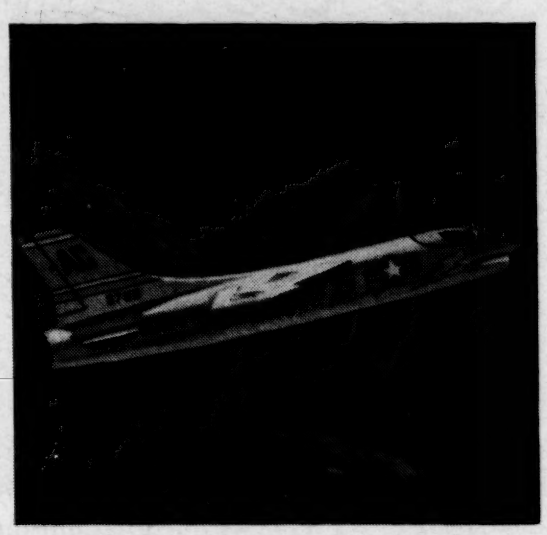
The sequence continues through scheduling, dispatching and operations evaluation. Continually updated cost and performance figures keep management informed of every phase of production.

Any change entered into the system is automatically reflected in all other control data. The compensation is made according to a prearranged plan—*your* plan—so that all controls are working toward your *current* objectives.

MOS offers comprehensive control

Only with the total approach provided by MOS can you get such coordinated effort, such complete information, such tight operational control. Only with MOS can you study, *in advance* the effect of decisions yet to be made. For more information, call your local IBM office.

IBM® DATA PROCESSING

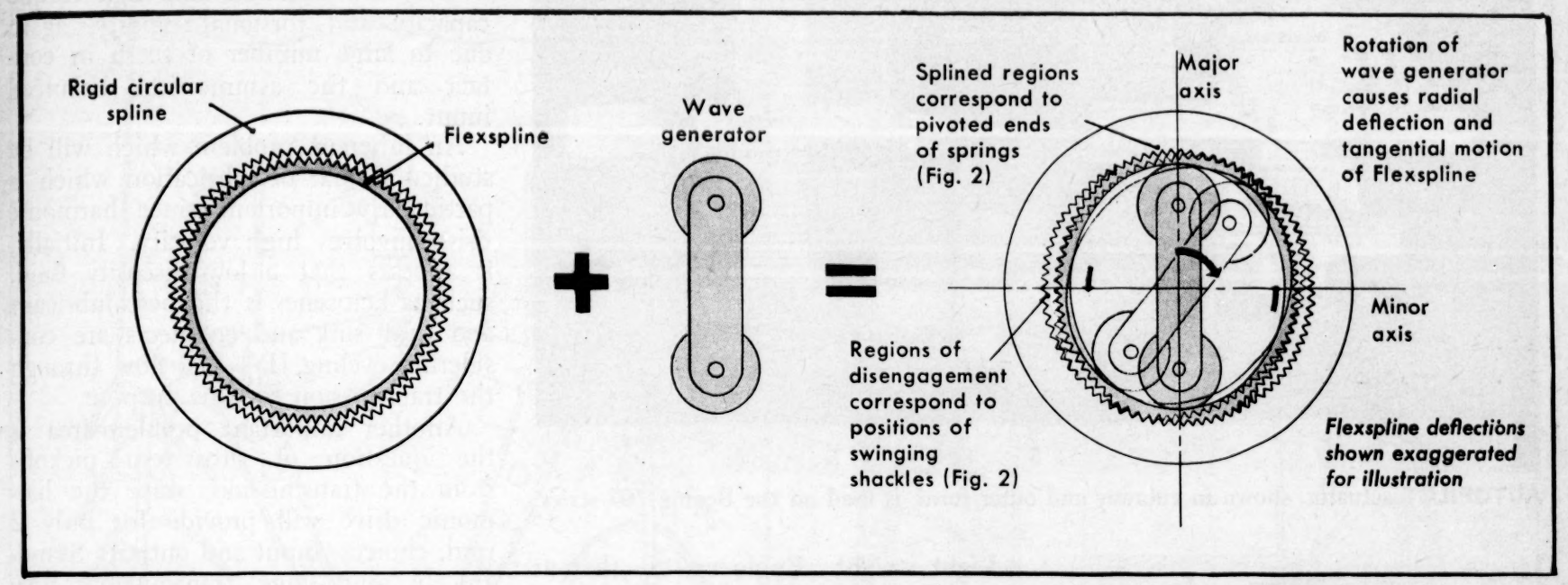


THE ABC'S OF CRUSADER POWER

Fighter for fighter, the Navy's *Crusader* has logged more flight time than any other 1,000-plus-mph aircraft in U. S. service. Since 1958, this Collier Trophy-winner has flown the Free World's border-watch from Lebanon to Formosa. Over 700 carrier- and land-based *Crusaders* have carried the markings of Navy and Marine Corps squadrons.* This year they are being joined by a new *Crusader* — the all-weather F8U-2N. A missile-firing, radar-packed extension of the basic *Crusader* design, the -2N takes over the Peace Patrol at nearly twice the speed of sound!

CHANCE VOUGHT AERONAUTICS DIVISION DALLAS, TEXAS

*These markings are representative of the 28 Navy and Marine squadrons flying *Crusaders*.



WAVE GENERATOR (center) rotates within the inner Flexspline, deflecting it slightly from natural form into an elliptoid.

Kaman Studies Simplified Transmission

Bloomfield, Conn.—Investigation of a harmonic drive transmission, designed to cut helicopter weight up to 400 lb., will be carried out by Kaman Aircraft Corp. under a $98,000 contract from U.S. Army.

Kaman has set up a research team, headed by John J. Schauble, chief of dynamic stress, that will be aided by United Shoe Machinery Corp., Boston, Mass.

United Shoe Machinery adapted the system for a variety of uses, including a 78:1 autopilot actuator in Boeing 707 jet transports.

Basically, the harmonic drive system provides a three-piece unit, with two moving parts, that is capable of substantial reductions or speedups in a single stage.

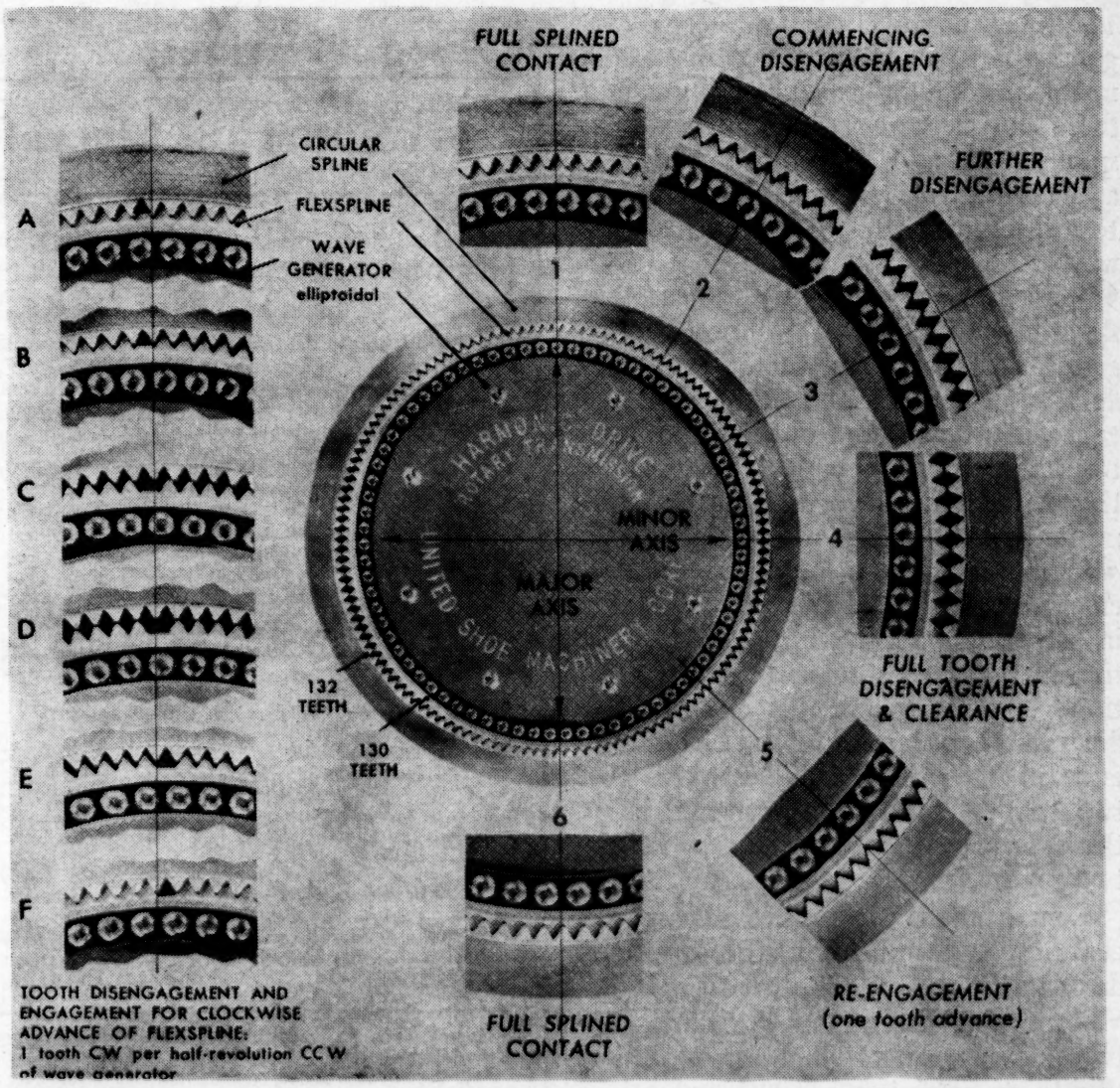
Kaman and the Army are interested in applying the concept to both helicopters and VTOL vehicles, to cut weight, complexity and noise. On the Kaman H-43B alone, the weight saving over the existing planetary transmission would be about 400 lb.

Contract calls for a four-phase program conducted over a 12-month period. Program includes:

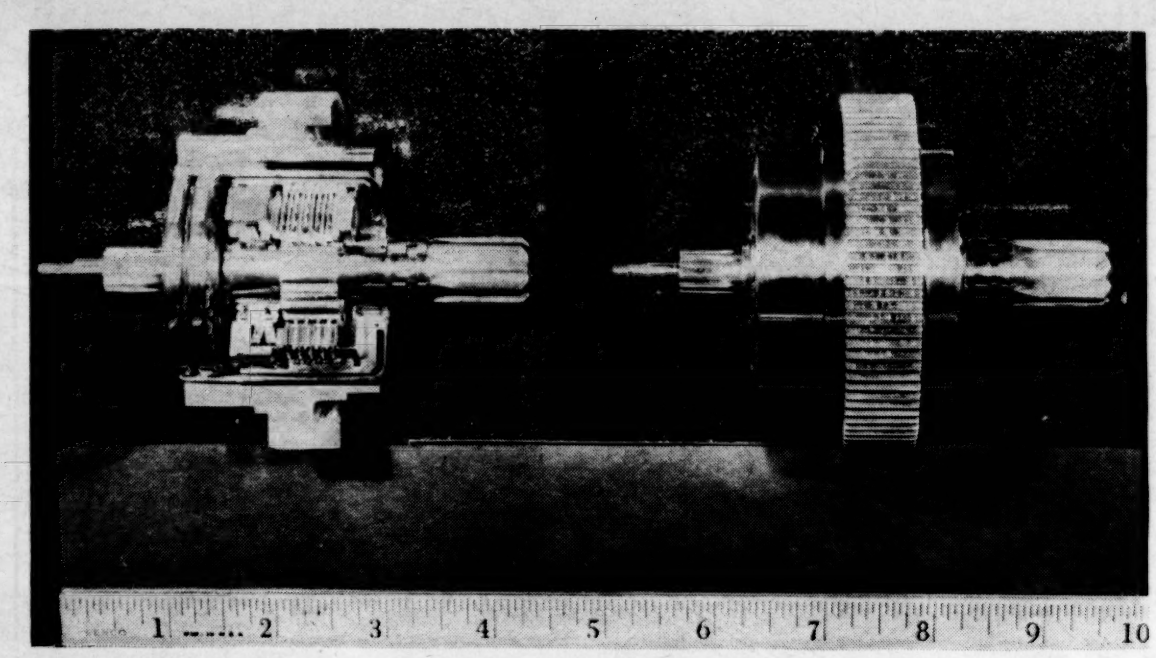
- **Phase I,** an analytical study of known design possibilities of harmonic drive gear train; design would be capable of absorbing 250 hp. at input speeds up to 50,000 rpm. and with a single stage reduction ratio of about 100:1.
- **Phase II,** apply results of design study toward design of a full scale feasibility model.
- **Phase** III, assembly and bench testing of the model.
- **Phase** IV, final report with recommendations and preliminary design of a specific light helicopter application.

At present, there are no plans to flight-test the harmonic drive system. However, Kaman has suggested to Army a follow-on phase for endurance test evaluation of the full-scale model, involving 20 hr. of total running time on a transmission rig. This phase is not funded.

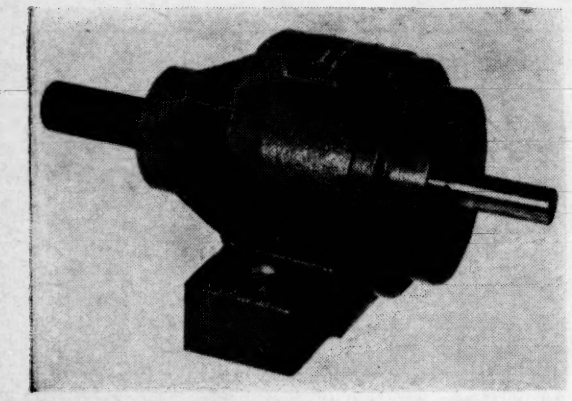
Harmonic drive is the name selected by United Shoe Machinery to describe dynamic aspects of non-rigid mechanics. Machine systems use the controlled elastic deflection of one or more parts for transmission, conversion or change of mechanical motion. Applications thus far include rotary-to-rotary motion transmission, rotary-to-linear motion



DRAWING shows successive tooth relationships about rotary harmonic drive for Flexspline with two teeth less than circular spline.



AUTOPILOT actuator, shown in cutaway and outer form, is used on the Boeing 707 series.



EXPERIMENTAL test unit, developed by United Shoe Machinery, has ratio of 100:1.

converters, and linear-to-rotary converters. Three basic parts to a harmonic drive speed reducer are the wave generator, flexspline and circular spline. Wave-generator is an elliptoidal cam with a major and minor axis. Flexspline is a thin flexible ring carrying external spline teeth and the circular spline is a rigid-toothed element that carries internal spline teeth. System works this way:

• **Wave generator deflects** the flexspline slightly from circular to elliptoid form, giving it a major and minor axis. Deflection of the flexspline causes splined engagement with the circular spline at two diametrically opposite regions on the major axis of the elliptoid; on the minor axis, the teeth are not engaged.

• **When the wave generator** is rotated clockwise, the flexspline rotates slowly in a counter-clockwise direction, relative to the fixed spline. In a full rotation of the wave generator, the flexspline counter-rotates by the difference in the number of teeth on the two splines, which also corresponds to the difference in circumferences of their two pitch circles.

Kaman and United Shoe researchers claim these advantages for the harmonic drive system:

• **Simplicity.** Essentially, there are only two moving parts which give a possibility of attaining a 100:1 reduction in a single stage.

• **Light weight.** Engineers say that at present a projected harmonic drive unit would weigh about half that of a comparable standard transmission unit.

• **Compactness.** As an example, the Boeing 707 autopilot actuator occupies one-third of the space needed for a conventional reduction device.

• **Noise reduction.** Noise evaluation of a 100:1 harmonic drive unit, performed by U.S. Naval Engineering Experiment Station last August, showed that no tooth mesh frequencies could be identified; gear produced chiefly white noise, in which all frequencies were in equal amplitude.

Other advantages, the engineers contend, are low cost, long life due to large number of teeth engaged during a single cycle of the wave guide, extremely low backlash and high torque capacity and torsional rigidity, again due to large number of teeth in contact and the symmetrical balanced input.

An inherent problem which will be studied is that of lubrication which is particularly important since harmonic drive involves high velocity. Initially, it appears that a low viscosity fluid, such as kerosene, is the best lubricant and heat sink and engineers are considering cycling JP-4 fuel flow through the transmission for this purpose.

Another important problem-area is the question of subsystem pickoffs from the transmission, since the harmonic drive will provide for only 2 rpm. choices—input and output. Standard, or multi-stage, transmissions now used can provide a variety of rpm. choices for the subsystems during the reduction phases.

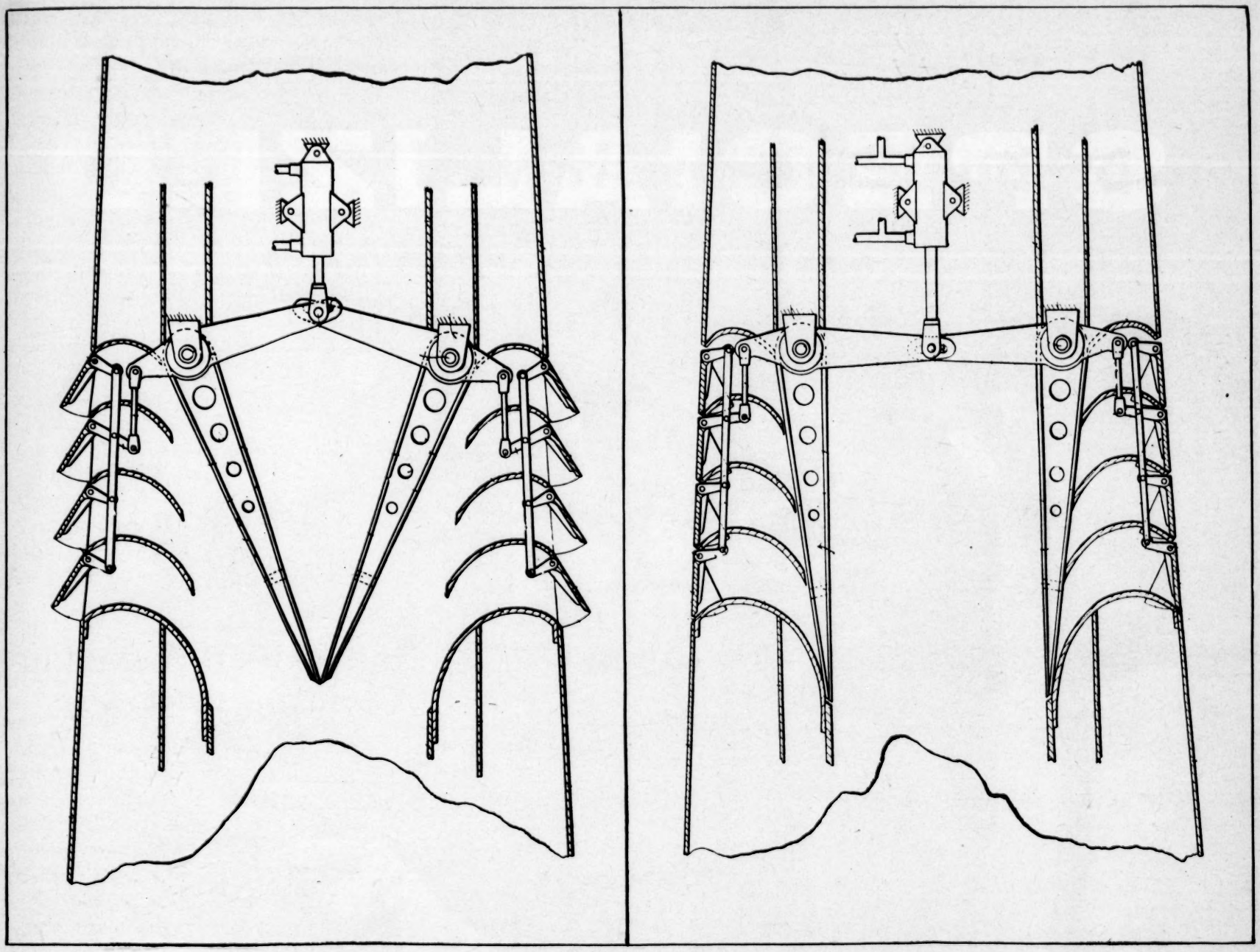
Initial B-70 Assembly To Begin in March

Preparation for B-70 assembly operations got under way with the arrival of tooling equipment at North American Aviation's Palmdale facility. Initial assembly is scheduled to begin in March following installation of the aft fuselage section jig. NAA's Los Angeles division announced that the B-70 workforce at Palmdale is expected to reach

Export of Aircraft Parts, Accessories

Item	October 1960		Cumulative totals January-October 1960*	
	Number	Value ($1,000)	Number	Value ($1,000)
Aircraft, parts, and accessories, total	.....	86,695	.....	1,139,205
Commercial and civilian aircraft, total	195	30,589	1,909	463,292
Aircraft 3,000 lb. and over empty airframe weight:				
Cargo transports, commercial, new	.....	.....	.....	.....
Passenger transports, commercial, new:				
3,000–14,999 lb. empty airframe weight	5	723	44	5,204
15,000–29,000 lb. empty airframe weight	1	1,097	8	7,042
30,000 lb. and over empty airframe weight	4	21,990	80	405,898
Rotary wing aircraft, commercial, new	1	107	7	2,122
Commercial and civilian aircraft, used and rebuilt, including converted	11	3,644	102	18,178
Aircraft under 3,000 lb. empty airframe weight:				
Utility, commercial and civilian, new:				
3 places and under	32	258	312	2,484
4 places and over	107	2,378	941	16,786
Rotary wing, commercial, new	3	153	57	3,039
Commercial and civilian aircraft, used and rebuilt, including converted	31	239	355	2,517
Commercial and civilian aircraft, new, n.e.c. (all empty airframe weights)	.....	.....	3	22
Aircraft engines, reciprocating, new air-cooled under 400 hp[1]	108	257	1,280	3,245
Aircraft engines, reciprocating, used and rebuilt	114	958	1,262	8,341
Aircraft components, parts, and accessories, n.e.c.[2]	.....	54,891	.....	664,327

Source: Foreign Trade Division, Bureau of the Census.
* Revised.
[1] Air-cooled reciprocating engines, new, 400 hp.and over are included in "Aircraft components,parts, and accessories," n.e.c.
[2] Includes military aircraft.



Republic Patents Turbojet Thrust Reverser Design

Turbojet thrust reverser design, patented by Republic Aviation, offers fully-modulated reverse thrust (left) to 70% of total power on the ground or in flight. The reverser, suitable for fuselage or pod engine mountings, may be located on a jet tailpipe forward of an afterburner. Actuation is hydraulic; however, if the hydraulic actuation fails, the reverser may be controlled manually. Suggested applications for the thrust reverser include modulating the reverse thrust during descents and on landing approach for steeper descents without excessive speed increases. Republic announced no present plans to build and test the thrust reverser.

1,000 persons by the end of this year.

An electric throttle-control motor for the B-70 has been designed and tested by North American to overcome problems of high temperature and airframe deflection in the Mach 3 bomber.

Designed to operate at temperatures ranging from −65F to 550F, the motor has a steel frame and wiring encapsulated in ceramic. Advantage of the system is the elimination of throttle rods and/or cables leading from the cockpit to the engine fuel control units. North American terms the new motor light in weight and highly reliable.

Mechanical Engineers To Hold Symposium

American Society of Mechanical Engineers plans to hold its Second Symposium on Thermophysical Properties Jan. 24-26, 1962, at Princeton, N. J.

Eric F. Lype, chairman of the Committee on Thermophysical Properties, has asked those interested in presenting reports at the meeting to submit abstracts to him by May 1 and final manuscripts by July 1. The address is: Dr. Eric F. Lype, Thompson Ramo Wooldridge, 23555 Euclid Ave., Cleveland, Ohio.

Swiss Mirage III-C Production Delayed

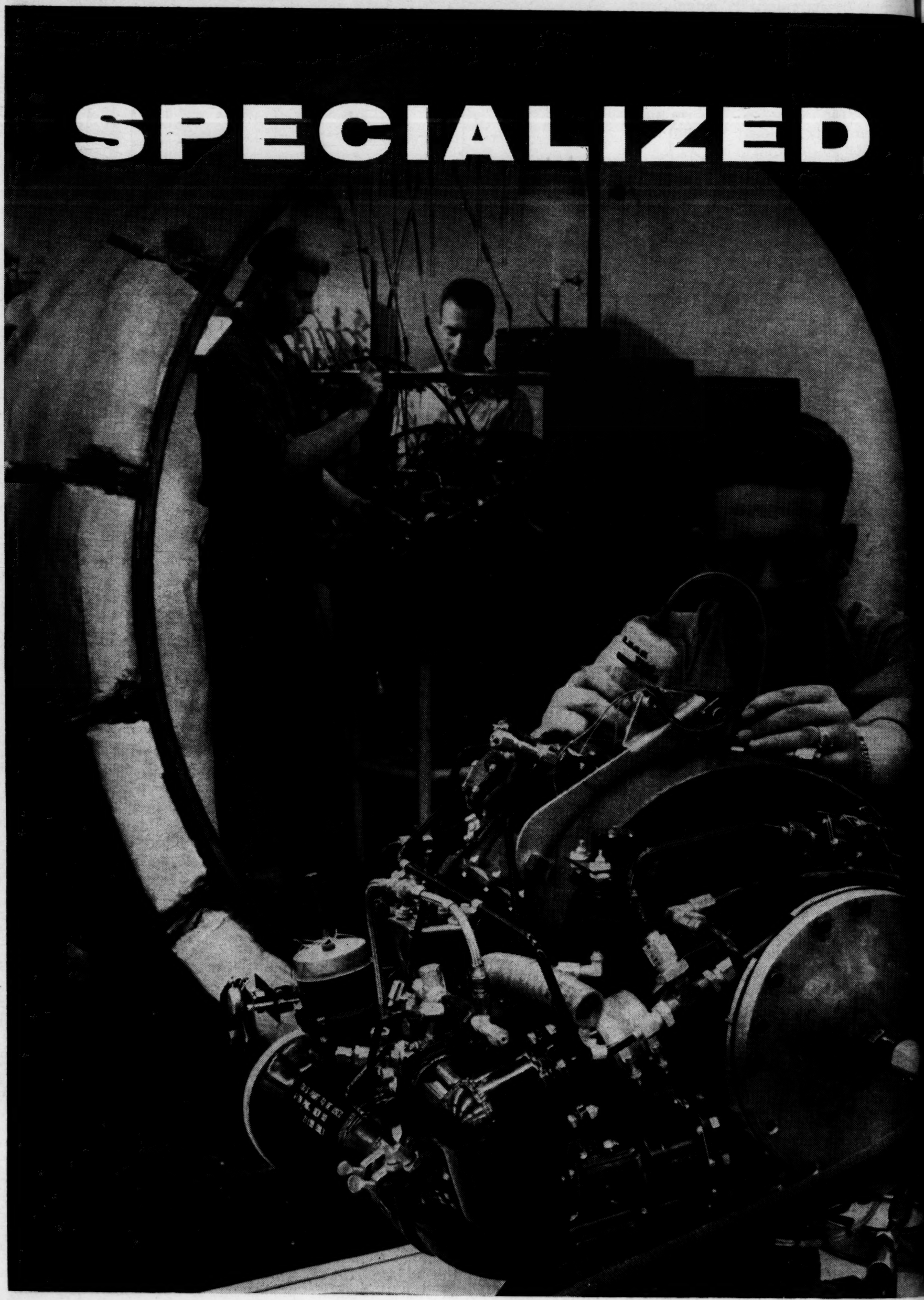
Berne—Parliamentary approval of the Swiss government's proposed licensed production in Switzerland of 100 French Dassault Mirage III-C aircraft for the Swiss air force (AW Jan. 2, p. 17), including three prototypes to be purchased from the manufacturer directly, is being delayed from March to June.

Paul Chaudet, head of the Swiss Military Department said that Parliament's approval would also be requested in June to equip the Mirage III-Cs with French Snecma Atar-9 engines. The British Minister of Aviation, Peter Thorneycroft, during his recent visit to Berne, had suggested powering the Mirage III-Cs with Rolls-Royce RB.146 turbine engines. These, according to Chaudet, would not only cost about $7½-million more, but probably would cause a slowdown in delivery of the aircraft because the airframes would have to be modified to accommodate the slightly larger Rolls-Royce engines.

Hallicrafters' Awards Total $37 Million

The Hallicrafters Co. has been awarded additional contracts by the Air Force totaling $37,100,000 for electronic countermeasure equipment on B-52 bombers. Of the $37,100,000, $19,500,000 is in the form of current countermeasure contracts and $17,600,000 represents a new letter contract which allocates funds for additional production of the same equipment.

SPECIALIZED



How Hamilton Standard factory overhaul cuts these important maintenance costs

1. **PERSONNEL TRAINING EXPENSE.** Many of today's aircraft components demand scrupulous engineering service which can be costly to you in manpower and training. At Hamilton Standard, nearly 500 thoroughly trained technicians and engineers concentrate exclusively on overhaul. For 42 years, the company has specialized in re-conditioning such components for virtually every U.S. commercial transport . . . a wide range of military fighters, bombers, transports . . . and private and executive aircraft. Examples:

   - **Jet fuel controls**
   - **Air-conditioning systems and components**
   - **Pressurization systems and components**
   - **Fuel-air and pneumatic starters**
   - **Propellers—blades, controls, gear boxes**
   - **Actuators**
   - **Valve assemblies**
   - **Electrical and electronic components**
   - **Test equipment**

2. **INVESTMENT IN SPACE, SPECIAL EQUIPMENT, PARTS.** Hamilton Standard maintains independent, fully equipped overhaul facilities with large parts inventories and the latest machine-shop and quality-control equipment. In addition, the company's extensive test chambers and development laboratories are available for special structural and operational testing of components.

3. **DOWN-TIME OF AIRCRAFT.** By efficiently programming all work, Hamilton Standard is able to provide exceptionally fast turn-around service: as little as 5 days on propellers . . . 5 to 10 days on most other components. Hamilton Standard's location—adjacent to Bradley Field, the Hartford-Springfield airport—also makes possible quick, convenient "Fly-in" service.

To learn how economically Hamilton Standard's specialized overhaul experience and facilities can aid your maintenance program, phone or write: Manager, Overhaul & Repair Department.

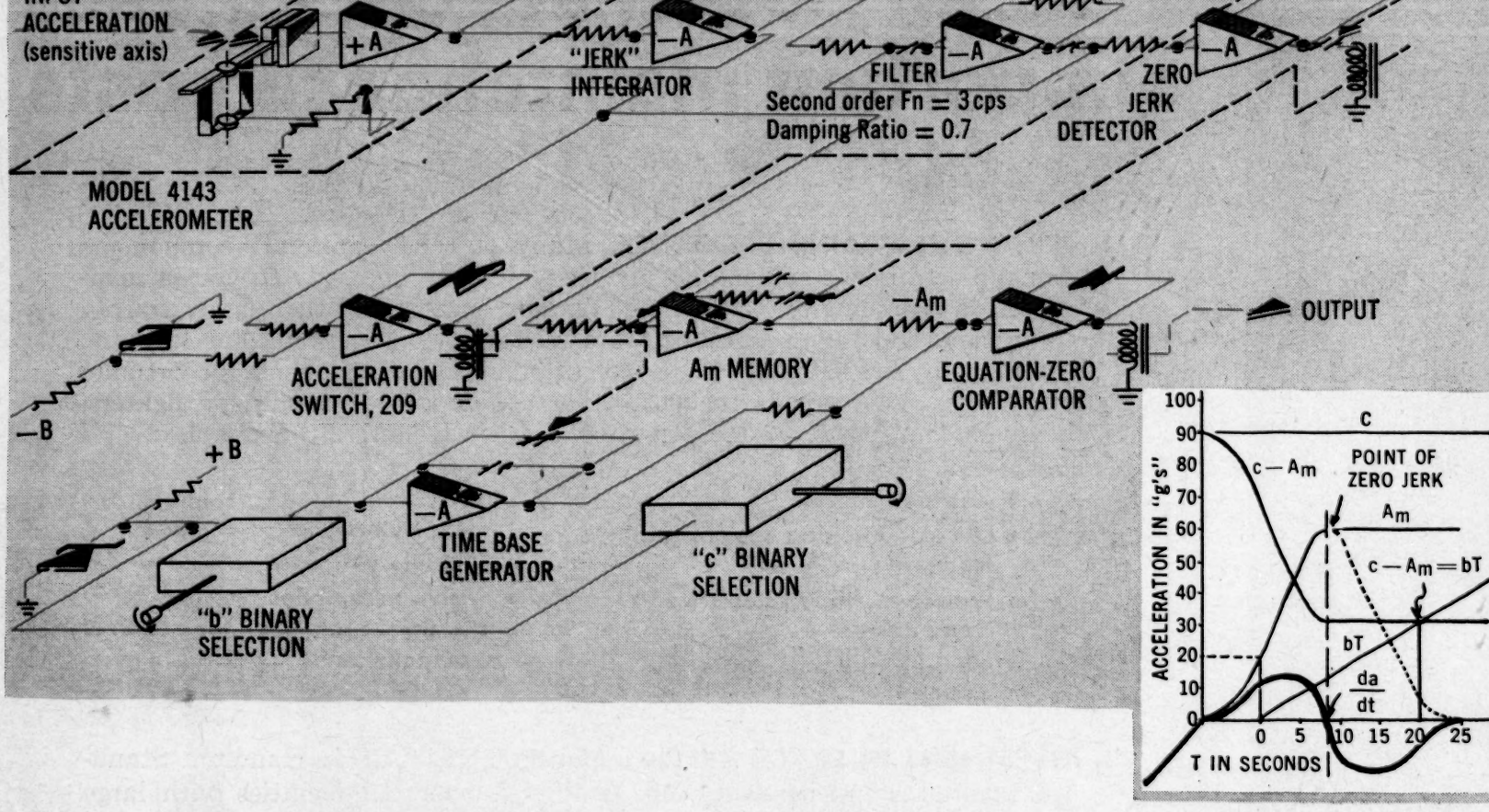
HAMILTON STANDARD

HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

Functional Diagram of Donner Accelerometer Timer Switch. Basically an airborne computer designed to solve a specific equation, this Donner device consists of a force balance accelerometer, whose output feeds to a jerkmeter for determination of peak acceleration (Jerk (da/dt) is the first derivative of acceleration). From the jerkmeter the signal passes through a filter and to a zero jerk detector which closes a switch at the peak acceleration. Other units in the computer are a peak acceleration memory, a 20 g acceleration switch which starts a time base generator and prevents the zero jerk detector from operating before a correct solution is possible, "b" and "c" selection binary units allow 64 values of "b" and "c" to be selected within the operating range, and an equation zero comparator which algebraically sums the output of the maximum acceleration memory circuit, time base multiplied by "b" and "c" circuit to close the relay output when $bT = c - A_m$. The curve below illustrates the equation and the fact that peak acceleration occurs at zero jerk.



How to Solve a Flight Equation

New Donner Airborne Analog Computer solves equation $bT=c-A_m$

where b = predetermined constant, T = time in seconds,
c = predetermined constant, and A_m = peak acceleration achieved.

Causing a missile event to occur at just the right time and place in space is one of the critical problems faced by the control engineer. The programming device must be light, accurate, strong and, above all, reliable in severe environments.

When Donner engineers were confronted with this problem, they came up with a fixed purpose airborne analog computer known more specifically as an acceleration summing switch. The summing switch is a "thinking" device which responds to a particular environmental stimulus. Thinking for the vehicle, the switch measures time, multiplies it by a preset constant, equates the product to the memorized peak acceleration subtracted from a constant and when the sum reaches a predetermined value, actuates a relay. Such a point occurs during decreasing acceleration and is dependent on the magnitude of peak acceleration.

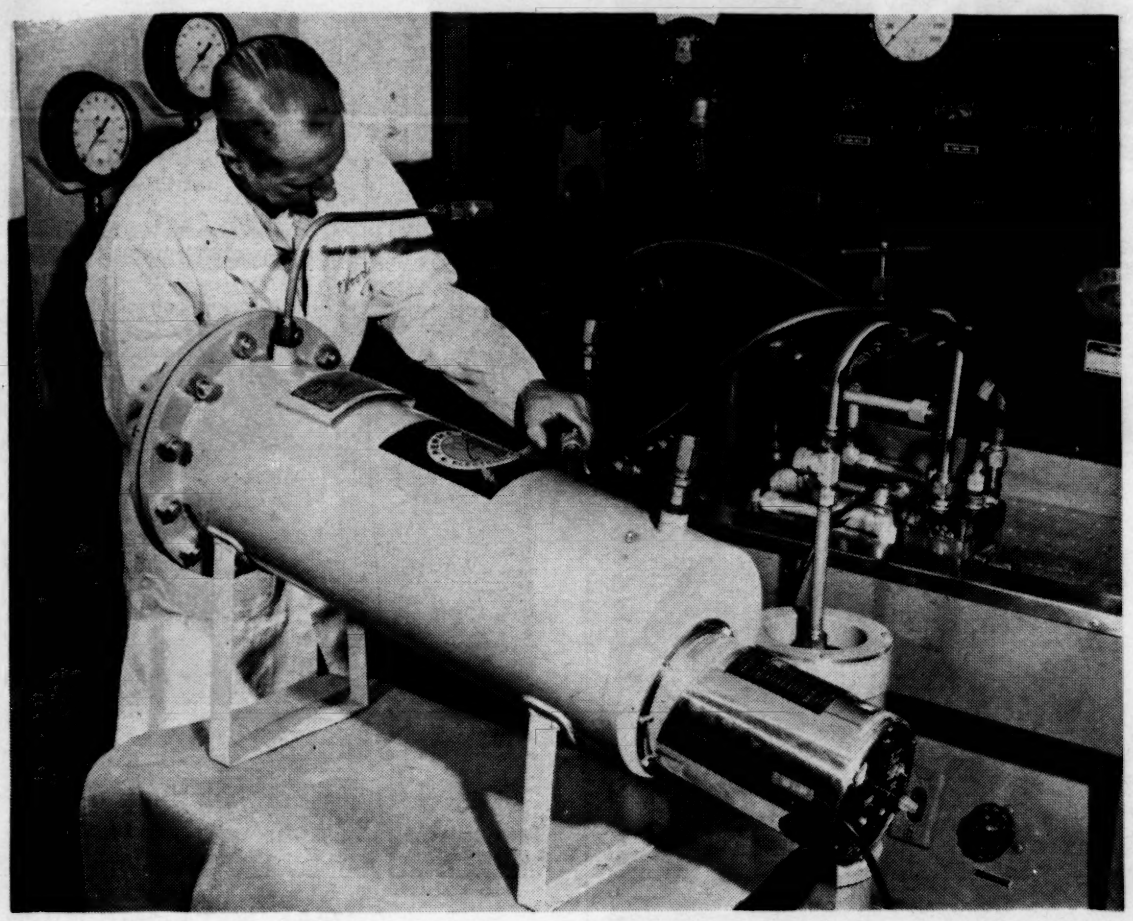
In solving this problem, Donner engineers combined their experience with computer techniques and servo force balance accelerometers. The device illustrated is all solid state.

Acceleration Summing Switch. This remarkable small computer is approximately 4" high and 2½" across. The two knobs on the top are used to set in "b" and "c" constants of the equation.

COMPLETE TECHNICAL INFORMATION AVAILABLE
If you would like more information about this interesting application of computer and transducer techniques, our Mr. Stephen P. Cuff has prepared a technical discussion which he will be happy to send along. Please write Mr. Cuff at Donner Scientific. Dept. 09

DONNER SCIENTIFIC COMPANY
A Subsidiary of SYSTRON—DONNER Corporation
CONCORD, CALIFORNIA

NEW AVIATION PRODUCTS



Filter Cleans Missile Hydraulic Systems

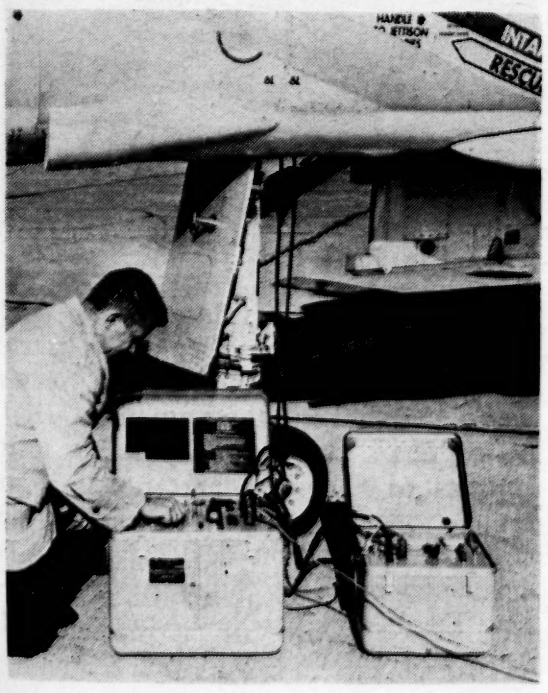
Electronic filter, called Perma Ray, is designed to remove contaminant particles from aircraft and missile hydraulic fluids and lubricating oil systems. The multi-pass filtration may be used to clean hydraulic test stands as well as missile and aircraft systems prior to flight. It is produced by the Permanent Filter Corp., Los Angeles, in a 3 gpm., 4,000 psi. model and a 10 gpm., 250 psi. model (above). Airborne and other special models are available.

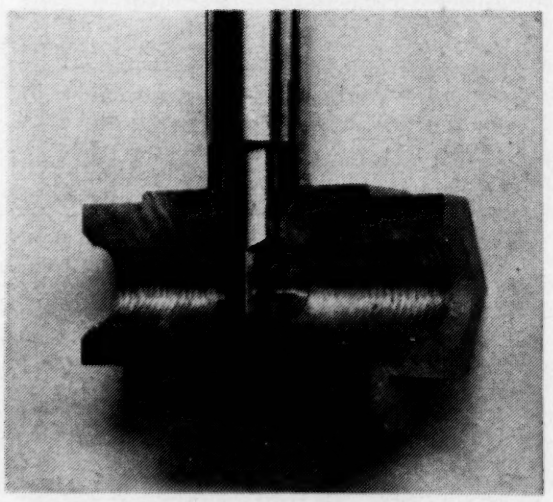
Pitot Static Tester

Portable pitot static system tester permits ground-testing of air data instruments and systems in aircraft and missiles without danger of damage due to excess pressures.

The Mast-R-Chek tester provides monitoring of altitude and airspeed envelope of any aircraft or missile to 80,000 ft., 850 kt. and Mach 2.5. Checks may be conducted on systems with leakage rates up to the maximum allowable for flight. Accuracies attained are: altitude, 30 ft. or 0.25% of indicated, whichever is greater; airspeed, 2% of indicated airspeed; Mach accuracy, 1.25% of indicated Mach number.

McDonnell Aircraft Corp., St. Louis 66, Mo.





Solenoid Shut-off Valve

Solenoid operated shut-off valve of stainless steel with aluminum body needs no O-rings or gaskets because of metal-to-metal seating of its sealing disk. Seal in the valve is bubble-tight, will close under back pressure and can be built to withstand up to 5,000 psi.

Valve is straight-through flow type and can be manufactured in normally open or shut models with port sizes of $\frac{1}{16}$ to $\frac{1}{2}$ in. Price, about $15 off the shelf, is comparable with valves using rubber seals.

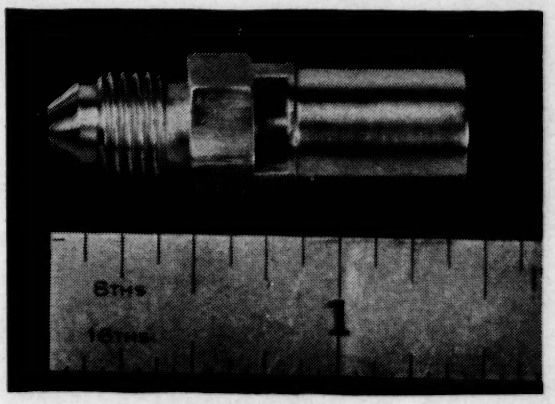
Polymet Co., Box 321, Orange, N. J.

Anti-Skid Control

Anti-skid brake control for jet aircraft is designed to give modulated control pressure rather than "on-off" action.

The electronic control monitors wheel deceleration and acceleration by means of an a.c. tachometer which generates a.c. voltage signals. A control valve provides braking pressure proportional to electrical input, but independent of fluid flow. The system is said to control skids from touchdown speeds to 3 or 4 mph. taxi speeds. The transistorized control weighs from 4 to 6½ lb., depending on control valve, to provide skid control for 4 wheels.

B. F. Goodrich Aviation Products, Akron, Ohio.

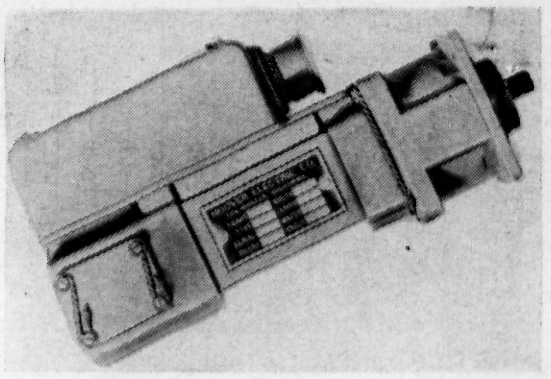


Hot Gas Relief Valve

Missile hot gas pressure relief valve, intended for liquid and solid fuel exhaust systems, incorporates a replaceable metal seat.

The relief valve is said to have low hysteresis characteristics. A typical design cracks, permits full flow, and reseats with 50 psi. in a 1,000 psi., 2,000F rocket exhaust system. Modifications of the valve have been successfully tested for an airborne closed-cycle refrigeration system.

General Pneumatics Corp., 158 Avon Ave., Newark 8, N. J.



Missile Motor

Fractional horsepower d.c. motor, designed for missile application, is adaptable to aircraft and ordnance uses. The motor has a short stopping time and a

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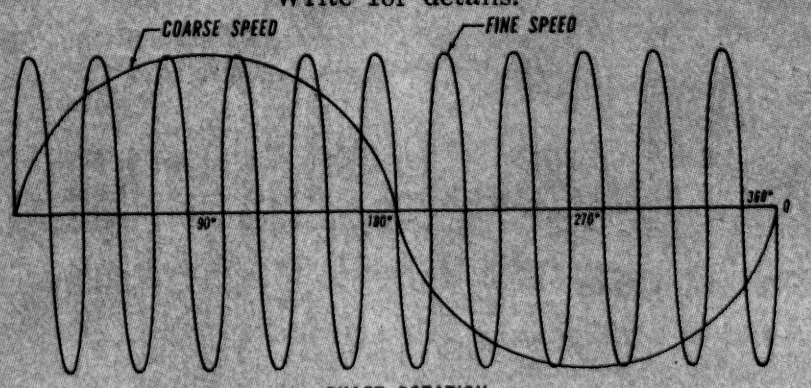

EXAMPLES OF APPLICATIONS: Fire Control Systems—Navigation Computers—Inertial Guidance Systems—Radar Antenna Tracking

Eclipse-Pioneer Division
Teterboro, N. J.

The Bendix Corporation

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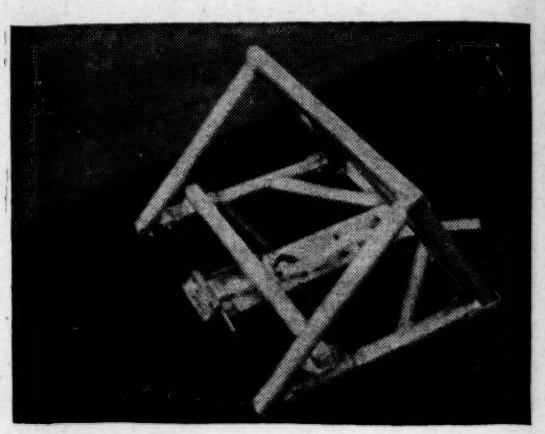
relatively high holding torque in the power-off condition.

The 26-v. Model 2030 motor is rated at 0.33 hp. at 14,000 rpm. continuous duty speed and 0.62 hp. at 8,750 rpm. intermittent duty. Weight of the motor is 4.75 lb.; efficiency is 45%. Dimensions are: length 7.48 in., width 2.44 in., height 4.31 in.

Hoover Electric Co., 2100 S. Stoner Ave., Los Angeles 25, Calif.

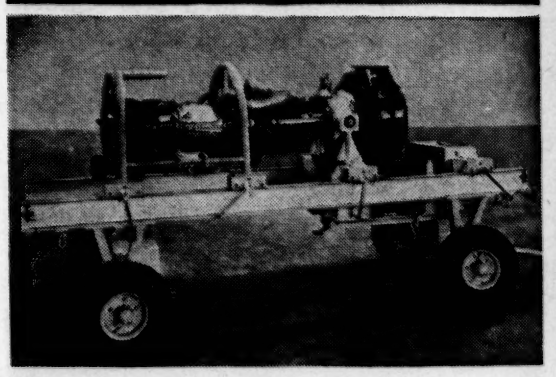


Aircraft Chock

Wheel chock for commercial, military and business aircraft is being evaluated on a Douglas DC-7B transport.

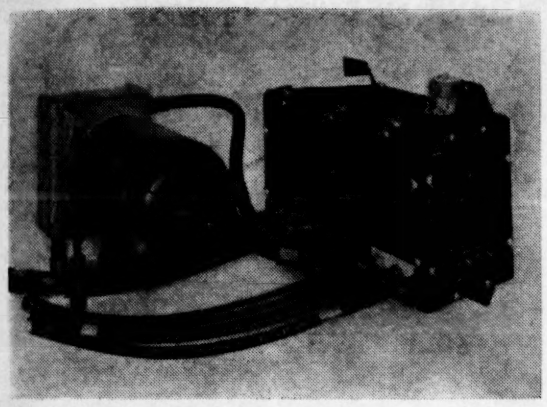
The all-metal chock resists high breakaway forces and will not float away under flood conditions. A quick-release mechanism on the chock permits easy freeing of a pinched chock. A manufacturer is sought for the chock by the patent holder.

International Development Co., 247 Park Ave., New York 17, N. Y.



Portable Test Cell

Portable test cell is designed for field maintenance of the General Electric T58 turboshaft engine in the Navy's Sikorsky HSS-2 and the Kaman HU2K-1 helicopters. The air-transportable unit consists of a control and fuel system trailer (top) and a trailer for the engine and load absorption device. Rig was developed by **GE's Small Aircraft Engine Dept.** and its **New York Aircraft Apparatus Service Shop, Linden, N. J.**



Avionic Cooling System

Ground support equipment cooling units are modifications of equipment designed for the Bendix Eagle missile.

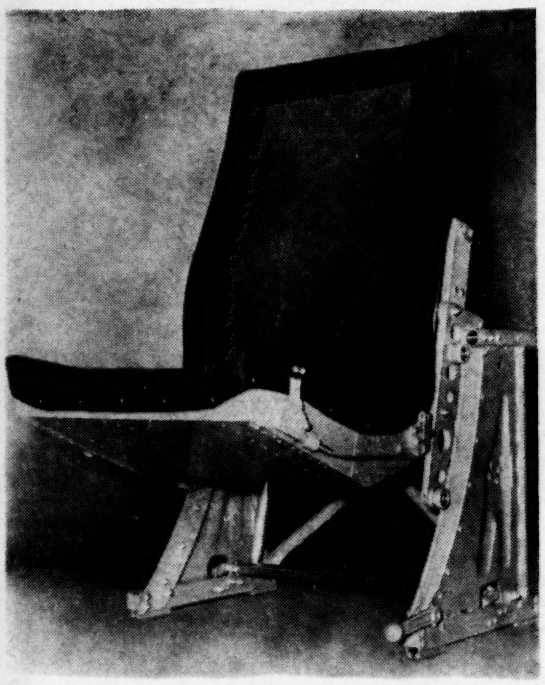
The liquid-to-air cooling unit, developed to cool the Eagle guidance system's klystron amplifiers, has a nominal heat dissipation rate of 9,375 watts. Other systems being developed for ground support applications have cooling capacities of from 100 to 10,000 watts. Operating temperature range of the units is from −65 to +250F.

Lear-Romec Division, Lear, Inc., Santa Monica, Calif.

Helicopter Crew Seats

Multi-position seats enable helicopter flight crew to maintain an upright position during forward motion, towing or other operations wherein the flight attitude is not horizontal.

The C115 seats, first installed on the Vertol YHR-1B, combine vertical and fore and aft travel with an incline mo-



tion produced by long and integral curved tracks mounted in vertical planes.

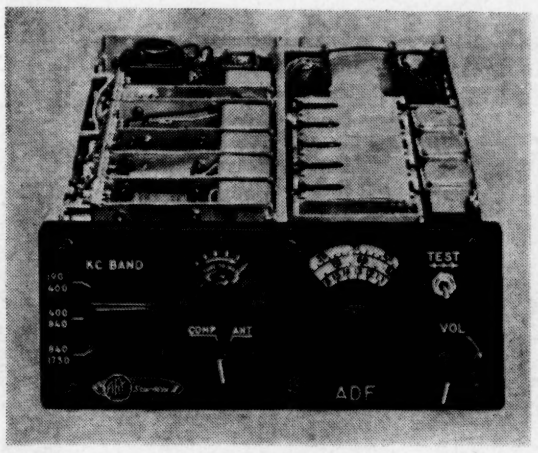
Incline adjustments may be made through 15 deg. of arc. Mesh seating material is employed to save weight and increase ventilation about the body. Seat weighs 30 lb., meets military specification. S 7832A.

Aerosmith Products, L. B. Smith Aircraft Corp., International Airport, Miami, Fla.

Panel-Mounted ADF

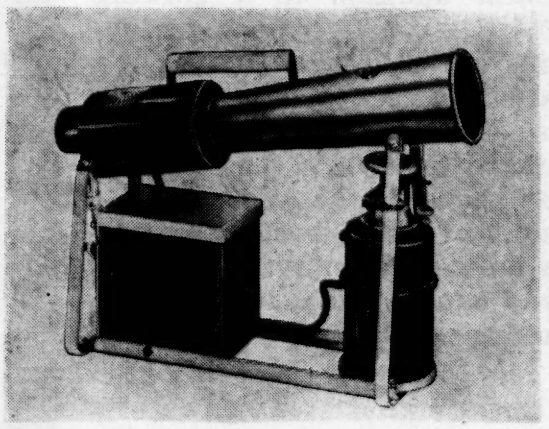
Panel-mounted automatic direction finder costing $2,150 is intended for business aircraft installation.

The StarFlite II Model 318A ADF incorporates a mechanically compensated L-11 loop with 14 compensation



steps for directional errors up to 25 deg. with no loss in sensitivity. The transistorized power unit draws 2.0 amp. at 27.5 v.d.c. Certified to TSO Category B, the system weighs 18.3 lb.

Aircraft Radio Corp., Boonton, N. J.



Airport Scarecrow

Scarecrow device, designed to frighten birds from airports and other areas, makes explosions at timed intervals.

The Zon automatic scarecrow, developed in Holland, uses acetylene fuel. A valve regulates the flow of gas and its adjustment determines the firing interval. The gas drives a piston, which cocks the firing mechanism, a flint and wheel. When sufficient gas accumulates, it is released into the combustion chamber and ignited. The portable device may be timed to operate only during high density bird traffic.

B. M. Lawrence & Co., 244 California St., San Francisco 11, Calif.

Doppler Indicator

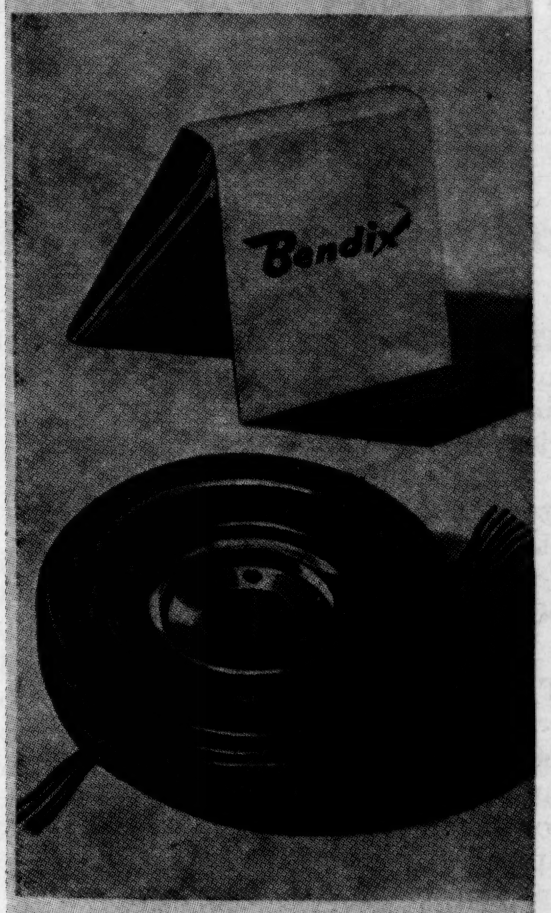
Doppler cockpit indicator combines the ground speed and drift angle display with a cross-track displacement display from a navigation computer.

The Type 37900 instrument permits the cross-track displacement reference on a separate course deviation indicator and may be used for VOR navigation.

Eclipse-Pioneer Division, The Bendix Corp., Teterboro, N. J.

ENGINEERING
REPORT
ON OTHER BENDIX COMPONENT PACKAGES

NEW 2-SPEED "PANCAKE" SYNCHRO TRANSMITTER



Resists stresses and temperature extremes

This compact, two-speed "pancake" synchro transmitter consistently exhibits an accuracy within thirty seconds of arc under dimensional stresses and wide temperature variations. The same order of accuracy is maintained when the transmitter is used back-to-back with a conventional two-speed control transformer. The synchros are operable from −55°C. to +200°C. They are logical replacements for existing mechanical two-speed transmitters. Their bantam weight (5 oz.) and small size (2.685" O.D. x 1.002" I.D. x 0.562" thick) suits them ideally to vertical gyro gimbals and other assemblies where size and weight are critical factors. Write for complete information.

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Newest addition to a growing line of G-E Voltage-tunable Magnetrons is the Z-5429. This tube's broad-band frequency range suits its use as a local oscillator in radar receiver circuits. A complete r-f power package, the tube gives a minimum of one milliwatt of linearly voltage-tuned power over the entire X-band range, without mechanical adjustment.

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K	—	35.0–40.0 14.0–18.0
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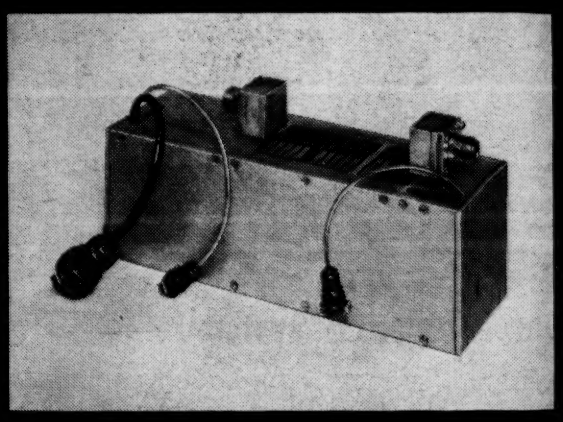
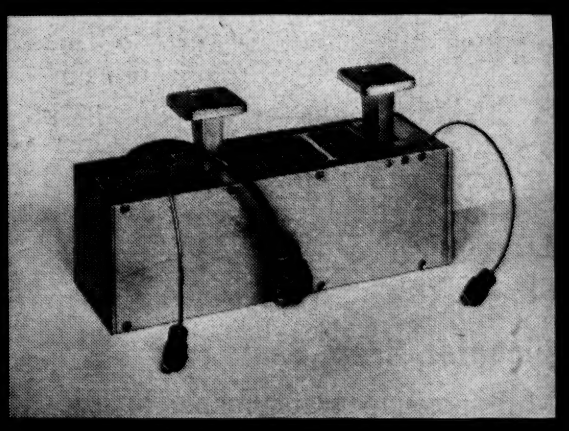
NEW TRAVELING-WAVE TUBES

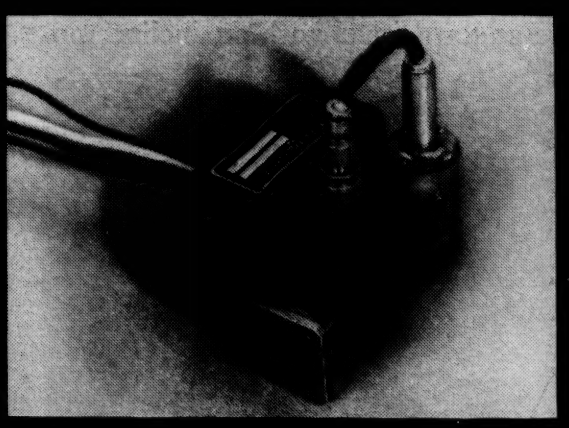


Z-3103 7.0-11.0 Kmc, 5 mw Output, 10 db Max. Noise Figure



Z-5259 8.0-12.0 Kmc, 5 mw Output, 10 db Max. Noise Figure

NEW VOLTAGE-TUNABLE MAGNETRON



Z-5429 8.5-11.0 Kmc, 1 mw Output (min.), 9.0 mc/v Tuning Rate

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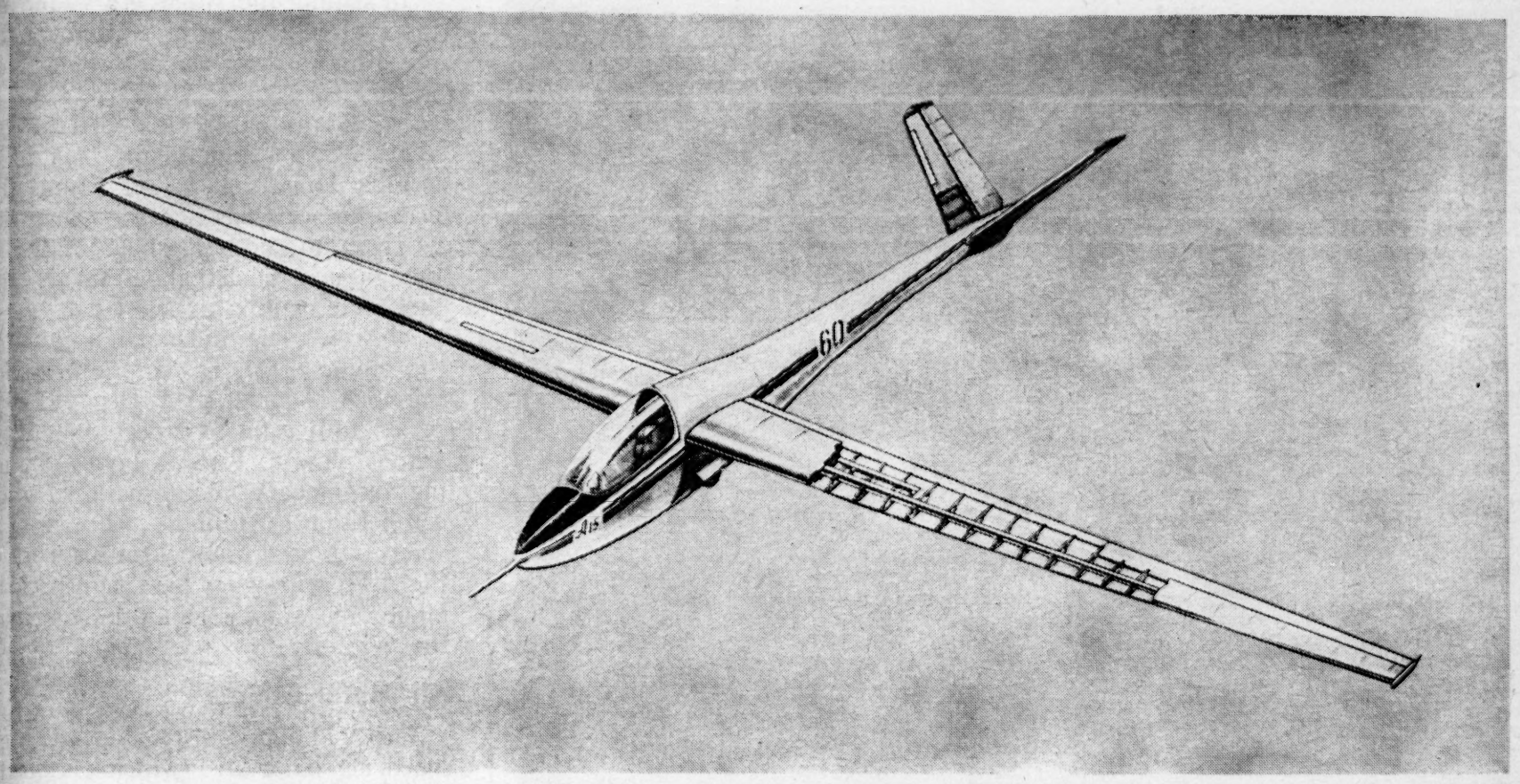


A-15, new all-metal Soviet glider, designed by O. K. Antonov, is 23.6-ft. long with a 55.8-ft. wing span. Cutaway section shows spar-rib relationship; speed brakes are located behind the spar between the seventh and 10th rib sections. Slotted flaps are extensible.

Soviets Repair Glider Fortunes With A-15

Russia's intensive effort to rebuild its fortunes in international gliding competition shows signs of paying off.

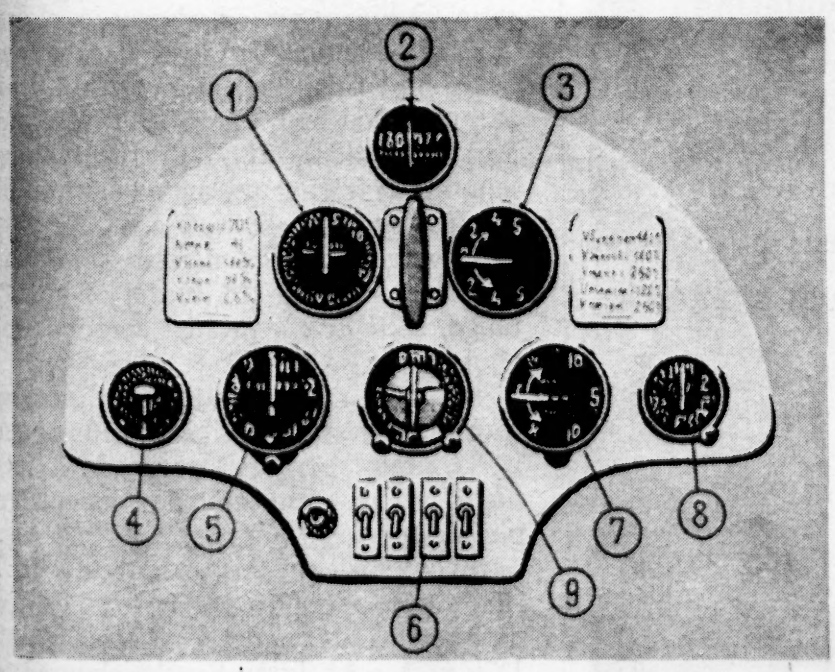
After a series of setbacks in the 1950s, the Soviets last year began making successful assaults on world gliding records. The Russians believe they now have the high-performance equipment and skilled pilots necessary to take over a majority of the glider marks recognized by the Federation Aeronautique Internationale.

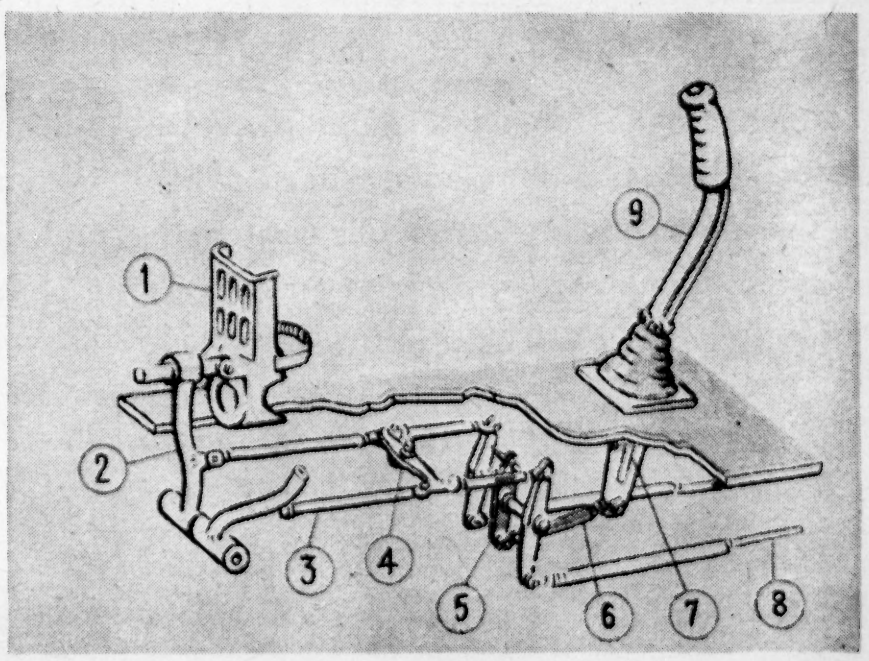
At the end of 1959, only two Soviet pilots held world glider records. They were V. Ilchenko, whose distance mark of 829.822 km. (515.3 mi.) for multiplace gliders was set in 1953; and O. Klepikova, whose women's distance mark of 749.203 km. (465.3 mi.) for single-place gliders goes back to 1939.

By the end of last summer, the Russians were claiming eight of the 32 glider records registered by FAI. Much of the credit for the Soviet comeback is given to the single-place Antonov A-15 glider, unveiled in the spring of 1960.

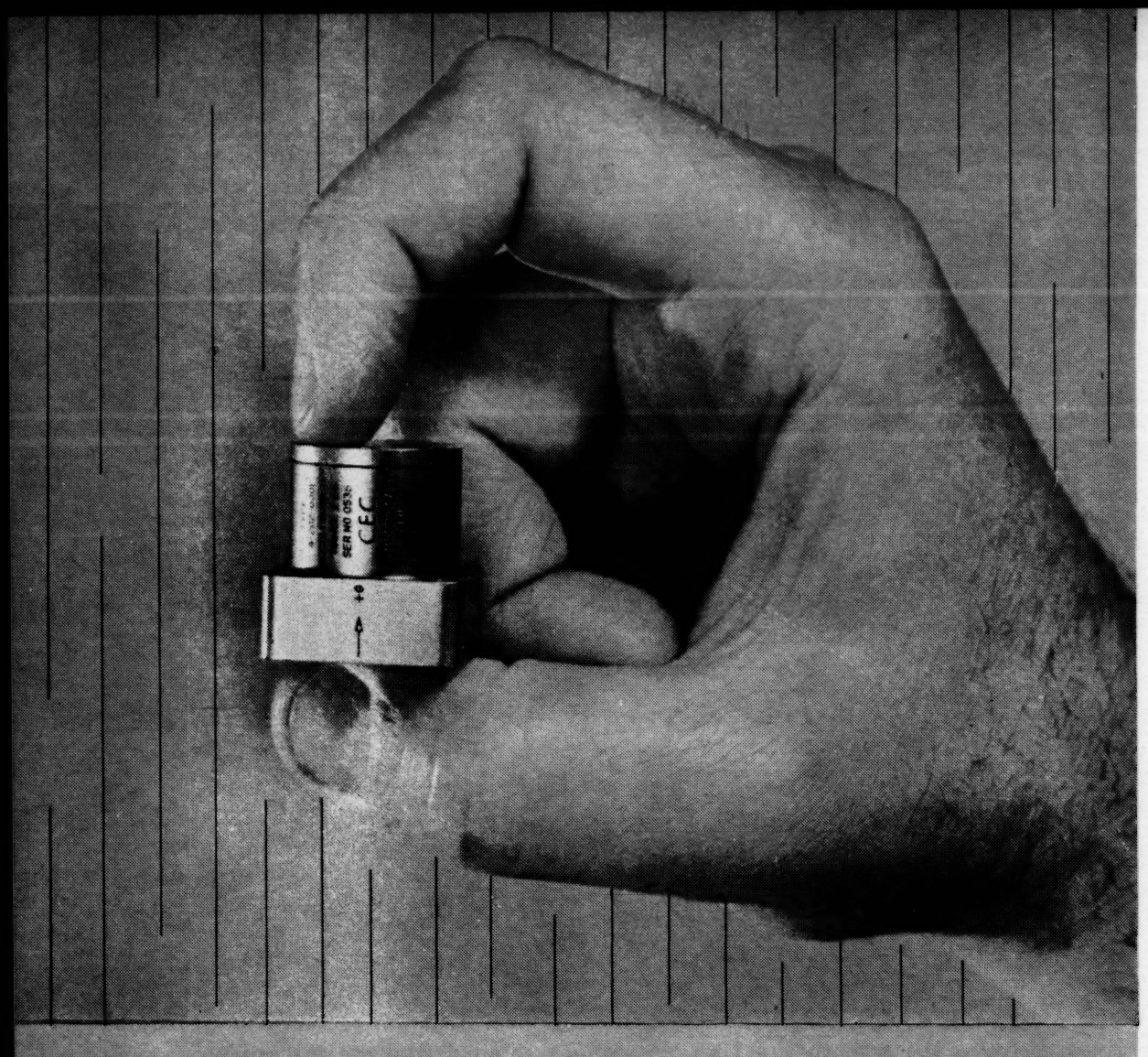
Record performances for the all-metal A-15 last year included two by M. Veretennikov, who averaged 111.388 kph. (69.17 mph.) over a 100-km. closed course and flew a distance of 714.023 km. (443.4 mi.) to a predetermined destination.

In addition, Soviet pilot Anna Samosadova flew an A-15 at an average speed of 70 kph. (43.47 mph.) over a





INSTRUMENT panel, detailed at left, shows (1) airspeed indicator, (2) compass, (3) sensitive rate-of-climb indicator, (4) oxygen supply indicator, (5) altimeter, (6) radio and instrument power supply switches, (7) rough rate-of-climb indicator, (8) thermal current indicator and (9) gyro horizon. Control diagram at right shows (1) foot pedal, (2) pedal actuating arm, (3, 4, 5, 6) components of mixing mechanism, (7) actuating arm for control stick, (8) rod to left rudder and (9) control stick.



Measuring perpendicular accelerations?

Look forward to spectacular performance from this tiny strain gage accelerometer! It's CEC's Type 4-202, the smallest temperature compensated instrument on the market.

Designed to measure accelerations perpendicular to mounting surfaces, it is available in a range of ±5g to ±500g.

These performance characteristics prove the 4-202 superior to any other linear unbonded strain gage bi-directional accelerometer: unusually low cross axis response... unusually high resonant frequency... extremely little damping change over a temperature range of –65°F. to +250°F.

For complete information, call your nearest CEC sales and service office or write for Bulletin CEC 4202-X7.

Transducer Division CEC

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

200-km. triangular course to beat the world women's record held by Wanda Szemplinska of Poland.

In hailing the A-15's feats (and also those of the two-place Antonov A-10), the Russian newspaper Moscow News declared:

"We must admit that after World War II Soviet glider sport took an extremely long time to get going. The reason for this was that for a long time we had no modern glider craft. Although new Soviet gliders were built, they were mainly trainers."

Moscow News did not mention that the failure of O. K. Antonov's highly-touted A-11 glider (AW Dec. 29, 1958, p. 74) to live up to expectations was a serious blow to Russian hopes of making a comeback in international glider competition. Antonov, who was severely criticized in 1959 for his work on the A-11, appears to have won back his reputation as a top glider designer with the A-15.

All-Metal Gliders

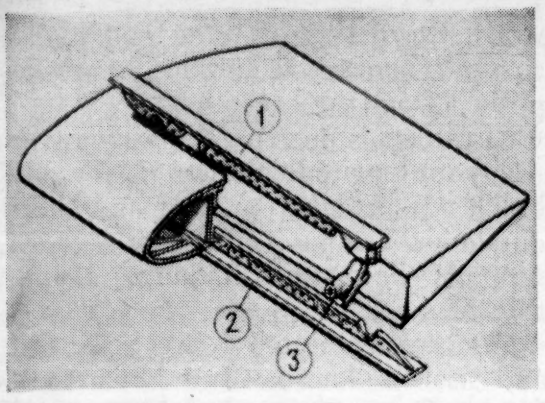
The A-11 and its sister ship, the high-speed, aerobatic A-13 (which has shorter wings but the same fuselage and tail assembly as the A-11), were the first all-metal gliders ordered into quantity production by the USSR's huge, semi-military sports organization DOSAAF (All-Union Voluntary Society for the Promotion of the Army, Air Force and Navy).

The V-tail A-15 draws considerably from the A-11 design, while correcting some of the latter's most serious defects. Wing span for the A-15 is slightly longer—17 meters (55.8 ft.)—against 16.5 meters (54.1 ft.) for the A-11. However, the A-15's wing area of 12 square meters (129.2 sq. ft.) is a bit less than the A-11's 12.15 square meters (130.8 sq. ft.).

Other specifications for the A-15 include: wing aspect ratio, 24; wing taper ratio, 3.15; mean aerodynamic chord, 2.52 ft.; dihedral, 1½ deg.; aileron area, 2 x 5.86 sq. ft.; flap area, 2 x 14.0 sq. ft.; unfolded tail span, 12.05 ft.; tail area (unfolded), 28.7 sq. ft.; fuselage length, 23.6 ft.; fuselage height, 3.82 ft.; fuselage cross-section area, 5.25 sq. ft.; flying weight depending on load variation, 803-935 lb.; center of gravity range, 26-35% mean aerodynamic chord.

The A-15's best gliding speed is close to 62.1 mph., permissible towing speed is 87 mph., permissible speed in free flight is 155 mph., and best calculated gliding ratio is 41.

By contrast, the A-11's length is 19.7 ft.; empty weight, 683 lb.; loaded weight, 881 lb.; and top gliding speed, 187 mph. At first, Russia claimed a best gliding ratio of 34:1 for the A-11, but subsequent tests showed it to be "no more than" 28:1.



A-15's speed brake mechanism shows (1) upper brake unit, (2) low brake slat and (3) lever arm for controlling unit.

In criticizing the A-11, a Soviet engineer declared that the craft "has flying and operating characteristics which represent a step backward as compared with existing glider types.

"The A-11 is notable for its great complexity in piloting technique. Aileron effectiveness at the beginning of takeoff and at the end of the landing run is inadequate.

"The wing's negative dihedral, the small ground clearance of the wing tips, the small relative banking angles, and the sharp, downswept wing tips require exceptional attention and precise piloting technique in landing and taking off.

"A small deviation in the glider's axis from the takeoff direction and any side drift cause swinging and rolling moments. As a result, in most cases, the glider's wing tip catches the ground . . .

"The A-11's general aerodynamic layout and design do not provide the opportunity for achieving good flying and operating performance. Despite its large dimensions, the fuselage volume is used irrationally . . .

"Because of the short arm, the tail assembly has a large area, which means high drag. This nullifies the advantages of the V-tail.

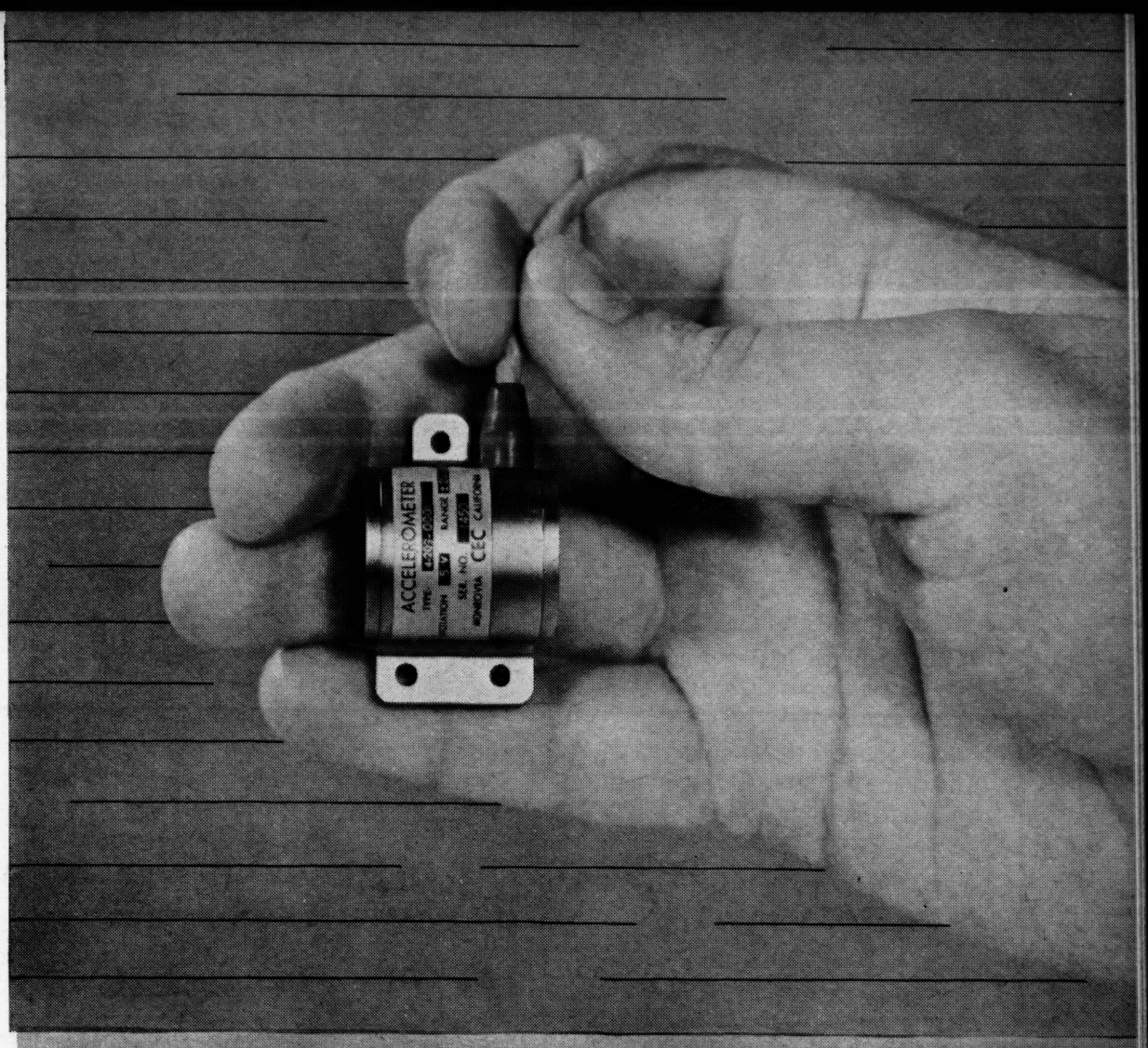
"It is difficult to understand how it is possible to get a high-performance glider when you place in the airflow large mass balances for the ailerons and tail controls, wells in the wing for them, heads for the ailerons' actuating arms, crude little hatches [covers] in these same places, and the unit for the wing flaps; and when besides all this the wing rivets protrude up to 0.3 mm. [0.01 in.] above the surface," he concluded.

Tapered Wing

As described by the Russian publication Krylya Rodiny, the A-15's tapered, monocoque wing "consists of two cantilever panels fastened to the fuselage center section. Longitudinal member is a single beam-type duralumin spar.

"Fore part of each rib consists of upper and lower halves which are not rigidly interconnected. This type of construction provides more precise profiling.

"Removable fairings in the form of



Measuring parallel accelerations?

Count on sensational performance from the newest addition to CEC's family of strain gage accelerometers! Type 4-203 packs all the superior performance characteristics of earlier models into just one cubic inch and less than three ounces.

Available in ranges from ±5g to ±500g, the 4-203 operates in a temperature range of –65°F. to +250°F.

In accurately measuring accelerations parallel to mounting surfaces, this miniature instrument performs with the lowest cross axis response . . . the smallest damping change with temperature . . . and the highest resonant frequency of any comparable instrument available.

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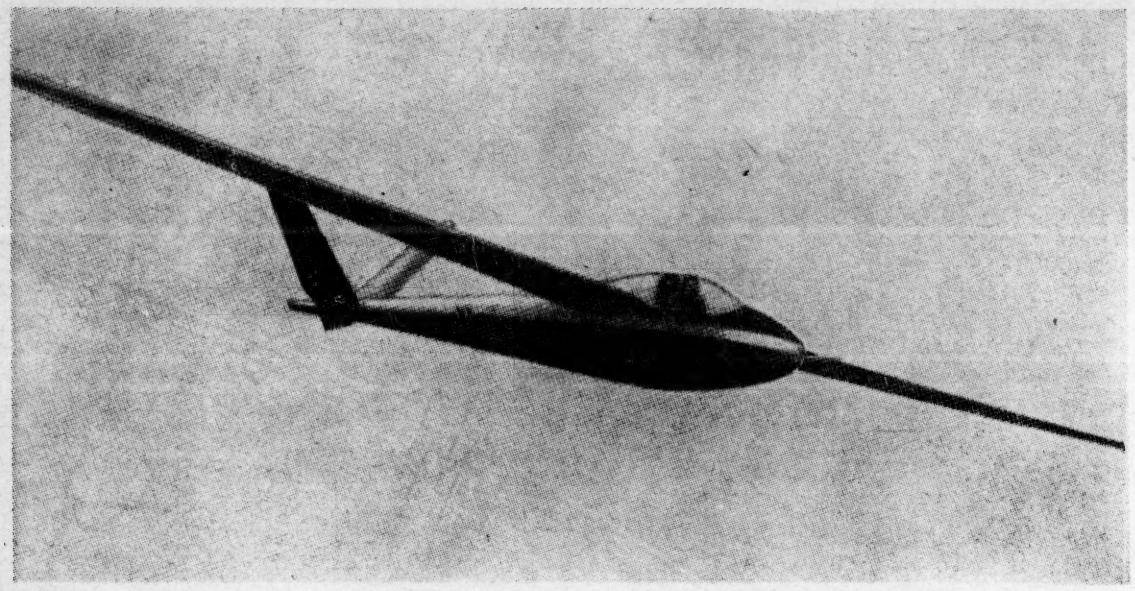
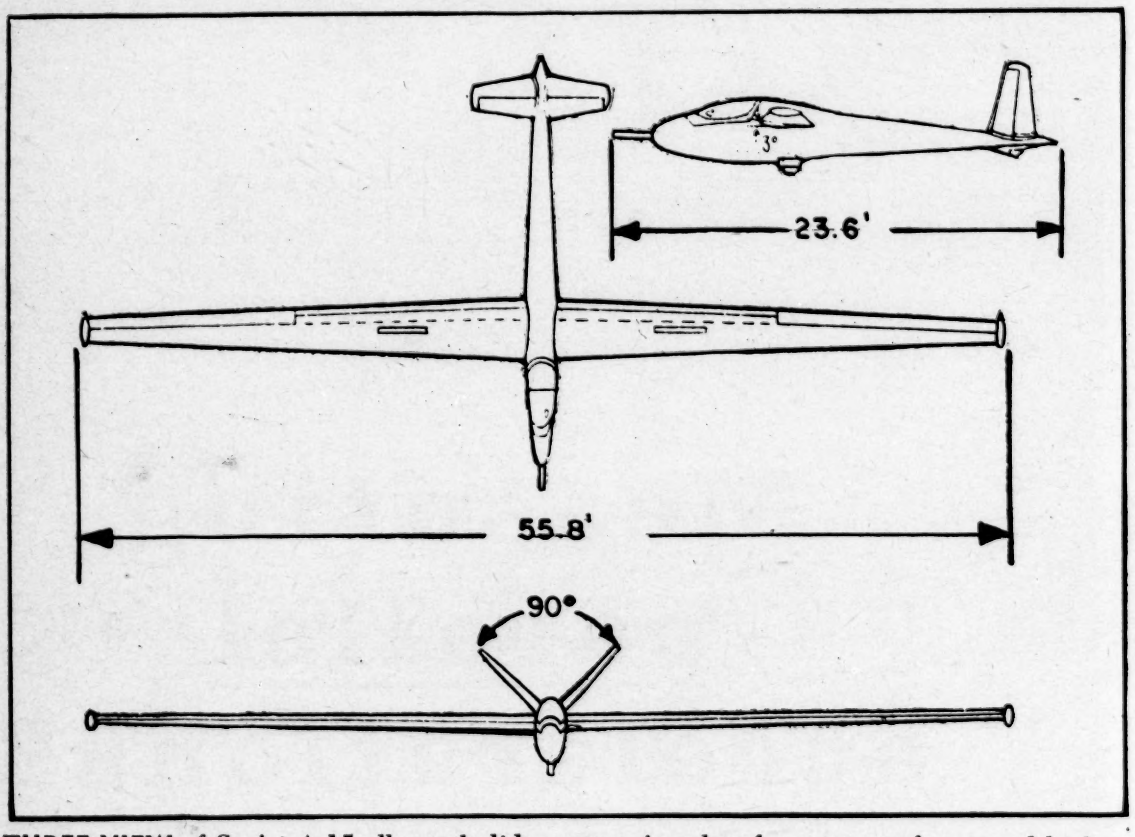


SOVIET A-15 glider has a retractable tow hook and skin is chemically milled.



THREE-VIEW of Soviet A-15 all-metal glider; note wing slats for upper surface speed brakes.

oval-shaped, plastic skid fins are attached to the wing tips. They protect the ailerons when the wing touches the ground and prevent the wing from digging into soft earth. In addition, the fairings somewhat increase the wing's effective aspect ratio, improving its lifting characteristics.

"The wing covering is of sheet duralumin in thicknesses varying from 1.5 to 1 mm. along the span. Intervals between the ribs are made thinner by means of chemical milling.

"One feature is the absence of skin seams located crosswise to the flow. The skin is riveted to the spar and the rear sections of the ribs. The ribs' front ends are cemented to the skin.

"The sturdy slotted ailerons (each of 4 meters span) are of unusual design. They consist of a duralumin spar, 39 foam plastic ribs, duralumin skin, and foam plastic filler. Each is fastened with six Cromansil hinges. The ailerons have 100% mass balance, which is achieved through the use of special weights and a mechanism which permits placing the entire layout inside the wing.

"The slotted flaps are extensible. They are of all-duralumin construction with foam plastic filler. The ribs are fastened with cement.

"Air brakes are installed behind the wing spar between the seventh and tenth ribs. They are extended perpendicular to the flow and to the wing surfaces—above and below. In closed position, the brakes are completely enclosed in the wing's contours.

Pin Attachments

"Attachment of the wing to the fuselage is accomplished with cylindrical pins at three points: at fittings along the upper and lower flanges of the spar and at the front end of the root rib. Corresponding fittings for attaching the fuselage to the wing panels are located in the upper part of the seventh and eighth bulkheads, where special fittings are installed.

"Two tanks for water ballast with a total capacity of 50 liters are in the wing. Regulation of water ballast discharge by means of a valve is accomplished from the cockpit.

"Fuselage is of semi-monocoque type—without longitudinal framing. Twenty bulkheads made of molded and sheet duralumin compose the framing which supports the duralumin skin of 1 mm. thickness . . .

"Cockpit is located between the first and sixth bulkheads. Interior arrangement and trim are designed to provide maximum convenience and comfort for the pilot during long flights. The relatively great height (including the canopy) permits freedom of posture for pilots as tall as 6 ft. 2 in. Use of plastics and light tones for equipment and decorative colors creates a pleasant environment for the pilot.

"The cockpit canopy is made of high-strength plastic fastened to a Cromansil tube frame. It opens on the right side. In emergencies, the canopy is thrown off to the rear. The canopy has a small window in front and to the left for vision under icing conditions."

Sealed Cockpit

"Cockpit is well sealed to protect the pilot against low temperatures at high altitudes. It is equipped with the necessary navigational instruments including speed indicator, altimeter, compass, rate-of-climb indicators with large and small scales, electric gyro-horizon and oxygen manometer-indicator.

"The oxygen system has a cylinder capacity of 0.7 cu. ft. at 2,200 psi. and feeds at altitudes from 13,100-39,400 ft. for 1-2 hr., depending on altitude.

"A lever for releasing the towline is installed on the instrument panel. It enables the tow hook to be retracted inside the fuselage.

"The portable radio transmitter-receiver has a range of up to 90 km. It permits the pilot to maintain communications with the starting point or a compass bearing when making triangular and other routed flights. Places are provided for installation of barographs during contests and record-making flights.

"A single-wheel landing gear which retracts in flight is located between the eighth and ninth bulkheads of the fuselage. The non-braking wheel is 11.8 in. x 4.9 in. in size. The landing gear's housing is insulated and tightly closed by doors in flight.

"The tail surfaces consist of fins set at a 45-deg. angle to the horizontal plane. Each of the tail's stabilizing surfaces is attached to the fuselage at three points (two bracing points on stamped bulkhead 19 and one on bulkhead 18). The stabilizing surfaces are of single-spar construction with frame of 19 duralumin ribs cemented to duralumin skin lightened by chemical milling.

"Frame for the rudders is a structure

consisting of a duralumin front section made of sheet material and a wooden tip. On their upper ends, the rudders have balancers which provide 100% mass balance. Control of the rudders, ailerons, flaps, air brakes and landing gear is rigid."

The Soviets have built a special, two-wheel trailer to transport the A-15 in fully-disassembled, partly-disassembled and fully-assembled condition. The trailer can be towed at speeds up to 60 mph.

Aviation Council Elects New Officers

Washington—Dr. William Requarth, president of the National Pilots Assn., has been elected chairman of the General Aviation Council, succeeding H. B. Wetherell, director of the Connecticut Aeronautics Commission. Joseph T. Geuting, Jr., manager of the Utility Airplane Council of Aerospace Industries Assn., was re-elected secretary-treasurer.

Council has decided to establish standing committees to study areas involving airports, airspace utilization, medicine, technical factors and airmen's standards and certification.

The group also named its executive committee: Aviation Distributors and Manufacturers, G. F. Quinby, ADMA official representative and vice president, National Aeronautical Corp.; National Aviation Trades Assn., J. Henry Stuart, president, and manager, Addison Airport, Dallas, Tex.; National Business Aircraft Assn., B. J. Bergesen, president, and manager Ford Motor Co. Aviation Dept., and National Pilots Assn., Dr. Requarth. Wetherell, as past chairman, becomes the fifth member.

PRIVATE LINES

Beechcraft Bonanza four-placer has been purchased by Leroy C. Cooper, Jr., one of seven military test pilots selected for Mercury astronaut training, from Atlantic Aviation Service at Philadelphia, Pa.

Bee Aviation Associates, San Diego, is trying to sell complete rights to manufacture and sell both of its airplanes—the Honey Bee and the Queen Bee. The certificated Honey Bee package, including engineering-manufacturing rights and one airplane, is placed on the market for $25,000. Bee is asking $50,000 for the Queen Bee package which includes engineering, one airplane, manufacturing rights and major parts for two additional aircraft. Without the parts for the two additional aircraft, Bee will sell the Queen Bee package for $25,000. The Queen Bee is presently in flight status, but has not received type certification.

Bay Aviation Services Co.'s Bell 47-J-2, under six-month contract to Corps of Engineers, will carry personnel from inaccessible building sites over a 3,200-mi area, where Minuteman missile launching sites are under construction at Great Falls, Mont. A pilot and mechanic are furnished by Bay Aviation. The helicopter will also serve as an ambulance or safety vehicle.

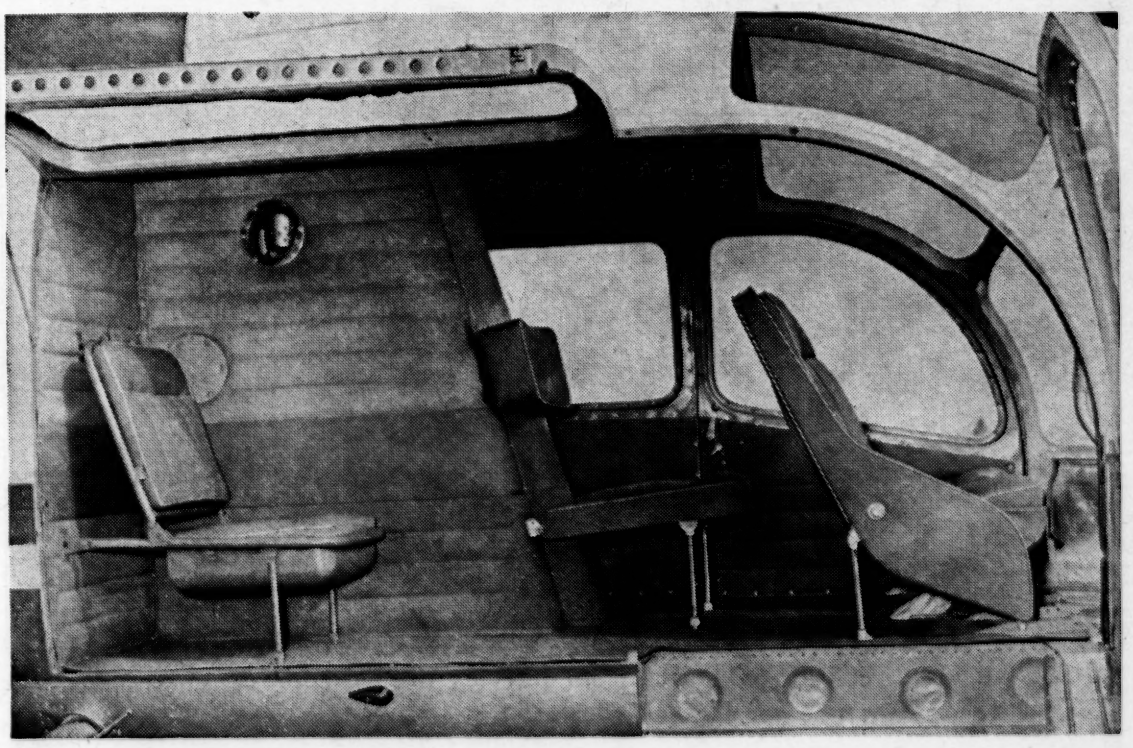
Mooney Aircraft Co. has received 150 orders for its new Mooney Mark 21 all-metal plane (AW Jan. 16, p. 108) and plans to double production to two planes per day in July. Norman Hoffman, president, said company should reach a volume of more than $7 million in 1961 and plans to add about 150 additional personnel to its work-force.

Business and utility aircraft sales last year reached more than $200 million, a record high which exceeded 1959 sales by $30 million, despite a slight decrease in unit production, according to Joseph T. Geuting, Jr., manager fo Utility Airplane Council of Aerospace Industries Assn. Higher volume was due to a greater number of twin-engine planes delivered—1,225 in 1960, compared with 996 in 1959. In exports, 1960 sales of 1,484 U. S. planes produced a volume of $27,335,023, it was reported by Irving H. Taylor, AIA export director.

Beech Acceptance Corp., wholly-owned financing subsidiary of Beech Aircraft, reported a 76.5% increase in volume in 1960 for a total of $21,113,121, highest in organization's history.

Czech HC-3 Undergoes Flight Trials

Aero HC-3 six-seat Czech helicopter, a development of the two-seat, 130-hp. HC-2 Heli Baby, is currently completing flight trials in Czechoslovakia. Aircraft is built by the Moravan Aircraft Works, Ostrokovice. Powerplant is a 240-hp. piston engine. The HC-3 is a general purpose helicopter suitable for ambulance and agricultural work, aerial photography and passenger-cargo transportation. Helicopter's interior can accommodate two stretchers and an attendant in addition to pilot for rescue or ambulance work.



Australian Accident Investigation Report, Part I:

F-27 Crashes in Sea During Approach

Following is the first part of a report to the Australian Minister of Civil Aviation on an inquiry into circumstances involving a crash of a Trans-Australia Airlines Fokker F-27 Friendship turboprop transport. Killed in the crash were the crew of four and 25 passengers.

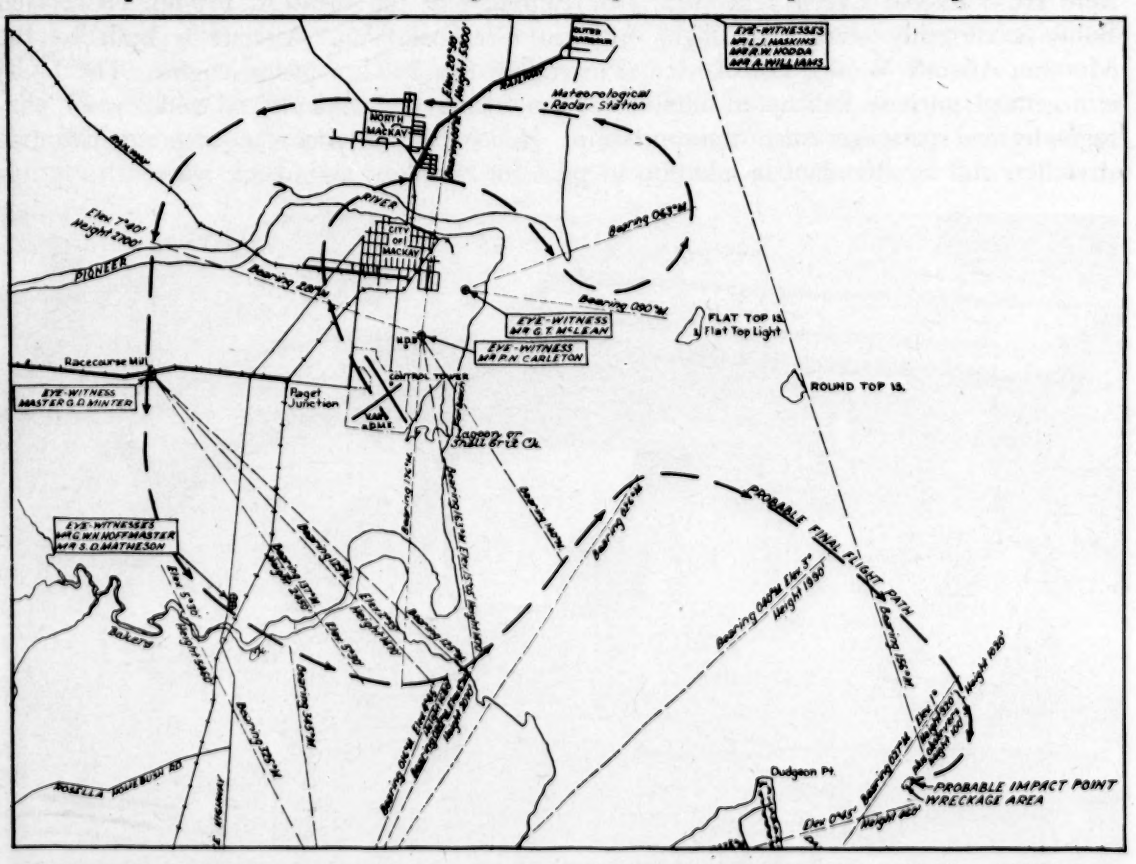
. . . At approximately 10.05 p. m. on June 10, 1960, Fokker Friendship aircraft VH-TFB, owned by the Australian National Airlines Commission and operated as part of Trans-Australia Airlines, entered the sea some 7½ mi. southeast of Mackay Airport. The aircraft was at the time approaching the Mackay Airport with a view to landing there in the course of a regular passenger flight from Brisbane to Mackay via Maryborough and Rockhampton. The aircraft carried a crew of four, and 25 passengers, all of whom were lost as a result of the fatality. The crew members were Capt. Francis Charles Pollard, First Officer Gordon Lloyd Davis, Hostess June Hamilton and Hostess Mary Katherine Wilmer.

The bodies of the captain, the first officer and eight passengers were recovered from the sea.

The aircraft, VH-TFB, was a high winged monoplane equipped for the carriage of 36 passengers, and operated by a flight crew of two pilots and two hostesses. As has been stated, it was owned by Australian National Airlines Commission, to whom Certificate of Registration No. 3240 was issued by the Director-General of Civil Aviation pursuant to the Air Navigation Regulations of the Commonwealth of Australia on April 6, 1959. The Australian National Airlines Commission operates Trans-Australia Airlines to which an Airline License No. 216 was issued pursuant to the Air Navigation Regulations on July 1, 1950. This license had been renewed from year to year and was currently operative on June 10, 1960.

The aircraft was first introduced to the regular public transport services of Trans-Australia Airlines on May 1, 1959. Subject to what appears hereafter in relation to the alleged omission of an overnight check at Mt. Isa on June 10, 1960, the aircraft had since been regularly maintained in accordance with the Air Navigation Regulations and Trans-Australia Airlines Maintenance Instruction Manual as approved by the Department of Civil Aviation. The radio equipment was maintained by Amalgamated Wireless of Australasia, Ltd., and had been regularly inspected and overhauled in accordance with procedures approved by the Department of Civil Aviation. A Certificate of Airworthiness for the aircraft was renewed on May 27, 1960, which subject to the provisions thereof and the requirements of Air Navigation Orders, was valid until May 26, 1961.

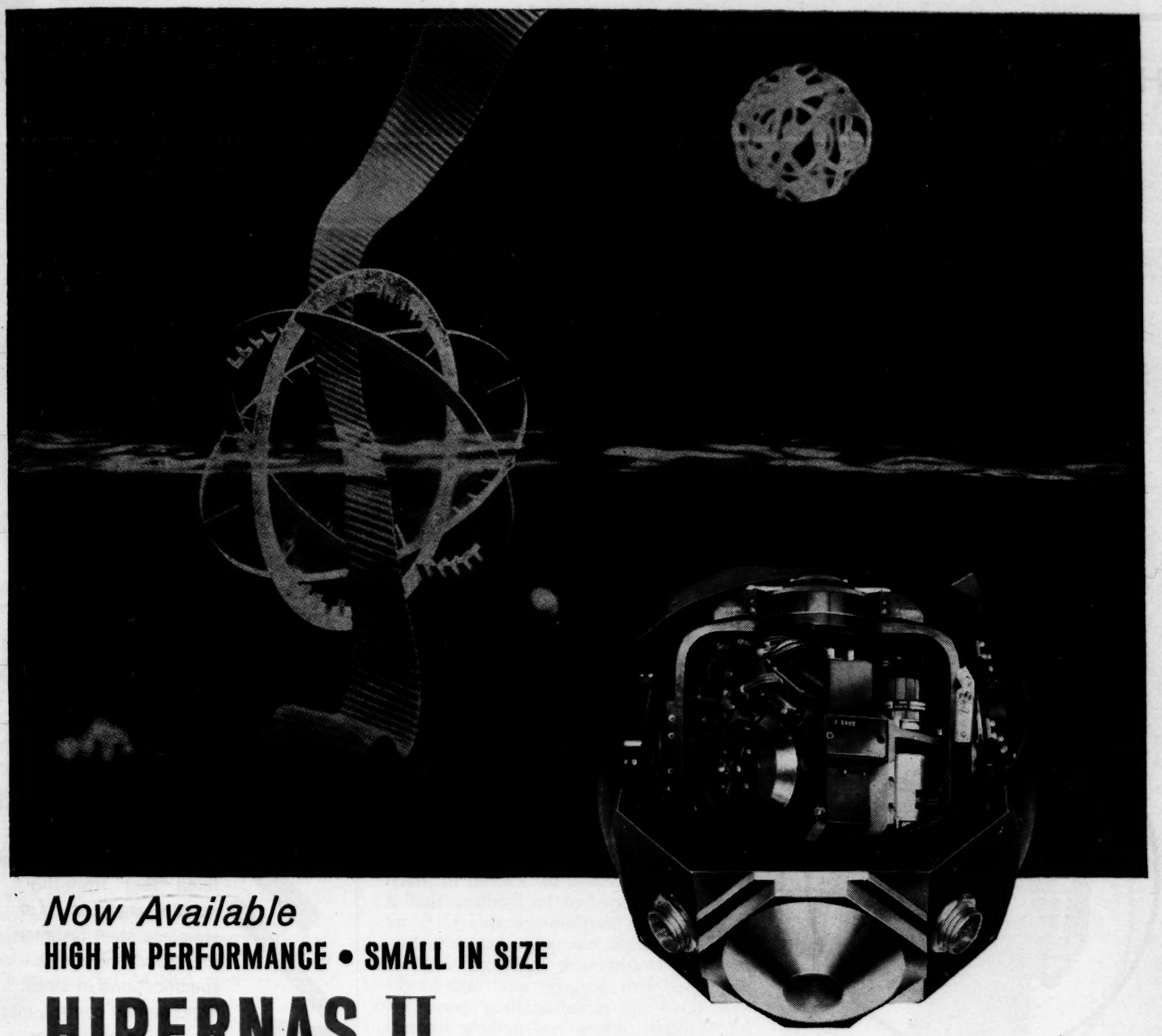
The captain, Francis Charles Pollard, was 36 years of age and had had considerable experience over a period of 16 years as a pilot both with the Royal Australian Air Force and Trans-Australia Airlines. He joined Trans-Australia Airlines as a first officer in 1949. He had a number of years' experience as a pilot of Douglas DC-3 aircraft. In 1954 he was promoted to captain (Grade 2) on DC-3 aircraft, and in 1957 he became a check captain on that type of aircraft. In 1959 his license was endorsed for Fokker F-27 aircraft and he was sent to Holland as first officer of a ferry crew for the delivery of a Fokker F-27 to Australia. In July of the same year he completed the training requirements for an F-27 captain. A month later, after appropriate training, he was appointed as a training captain for F-27 aircraft. In November, 1959, he became a check captain on this type with some 10,300 hr. total flying experience, of which 318 hr. had been flown on F-27 aircraft.



PROBABLE final flight path and impact point of Trans-Australia Airlines Fokker F-27 transport, which crashed June 10, 1960, is shown by broken line above.

The first officer, Gordon Lloyd Davis, was 24 years of age. He commenced his flying training with the Royal Aero Club of South Australia in December, 1952. He obtained a private pilot's license some 14 months later and a commercial pilot's license in July, 1956. He joined Trans-Australia Airlines in January, 1957, with a total of 221 hr. flying experience, in the course of which he had been employed by a light aircraft operator on aerial agricultural operations. In April, 1957, he obtained a 3rd Class Airline Transport Pilot License and was employed by Trans-Australia Airlines as a first officer on DC-3 type aircraft. In January, 1960, his 2nd Class Airline Transport Pilot License was endorsed for F-27 type aircraft. At the time of the accident First Officer Davis' 2nd Class Airline Transport Pilot License No. 280 was current and valid for Fokker F-27 type aircraft. He also held a valid Flight Radio Telephone Operator's License No. 1551 and a 2nd Class Instrument Rating endorsed for certain types of instrument flying. His total flying experience on the date of the accident was 2,428 hr., including 247 hr. as first officer on F-27 aircraft. These hours included 185 hr. of night flying, of which for approximately 11 he had been in command, and for 174 hr. was first officer. There is no doubt he was a fully-trained and competent first officer.

The evidence established that at the time of the accident both the pilot and first officer were fit and well, and there is nothing to suggest that there was any defect in their physical or mental condition which could in any way have contributed to the accident. Their activities on June 9 and



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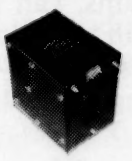

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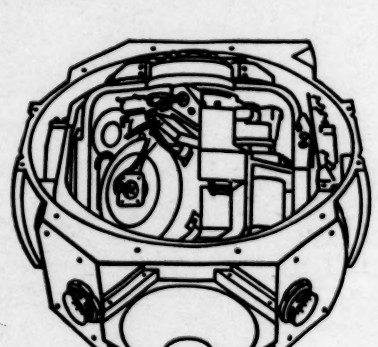

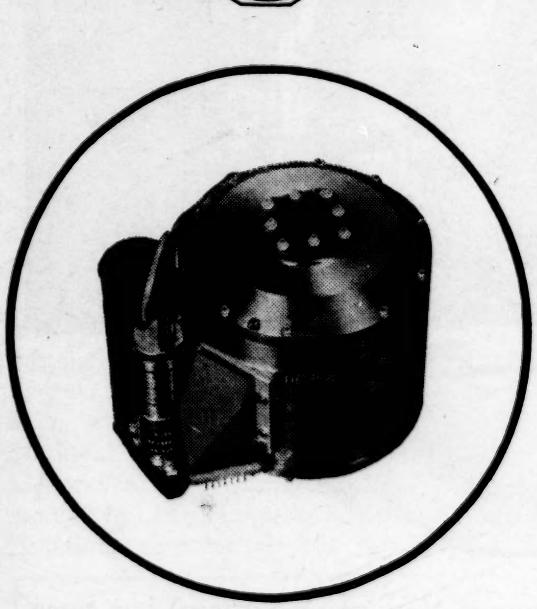

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on June 10 prior to the commencement of the flight Brisbane to Mackay did not involve any undue exertion and there is no ground for suspecting that they did not remain alert throughout the flight.

First Officer Davis was to undergo a proficiency check on the flight. Such checks are carried out with all pilots during normal flying operations at regular intervals of six months. They must not be confused with test or training flights. They are a necessary check on the proficiency of pilots in normal operations and must be conducted in the course of such operations.

Flight Plan

First Officer Davis arrived at the Brisbane Airport at about 3:50 p. m. and as he was to undergo the check already referred to, he expressed a wish to prepare the flight plan himself. He proceeded to do so and upon the arrival of Capt. Pollard, shortly after, he was assisted by him in that task. Some criticisms of the flight plan so prepared and of the load sheet for the flight will be dealt with hereafter. For present purposes it is sufficient to indicate that they refer to matters which have no relation to the cause of the accident.

The aircraft was due to depart from Brisbane at 5 p. m. In fact it was airborne at 5:11 p. m. and reported it was on its course at 5:13 p. m. It was a quite normal takeoff.

At the time of the departure of the aircraft there was nothing in the current meteorological reports to indicate that any abnormal conditions would be encountered in the course of the flight.

At 5:38 p. m. the aircraft reported its position abeam of Gympie flying at 9,000 ft., and it was cleared to descend to Maryborough. It reported to Brisbane that it had arrived at Maryborough at 5:52 p. m. At Maryborough, nine passengers with baggage and freight were discharged and six passengers with baggage, mail and freight were taken on, including three passengers for Mackay. There was nothing unusual in the arrival at or departure from Maryborough. The departure time was 6:12 p. m. and the aircraft climbed to a flight level of 15,000 ft. At 6:27 p. m. it reported its position over Bundaberg at that flight level and at 6:39 p. m. permission was sought and approval given to change the flight level to 13,000 ft. It reported again at the reporting position 70 mi. south of Rockhampton at 6:47 p. m. and it landed without incident at Rockhampton at 7:12 p. m.

At 7:10 p. m., the Air Traffic Control Officer at Mackay, on the basis of observations made by him there, issued a special weather report which indicated shallow ground fog at Mackay to a height of 20 ft. with a visibility of 880 yards. The controller at Rockhampton informed the aircraft of these facts immediately before the aircraft landed at Rockhampton. The information had reached that controller by means of an amended terminal forecast issued from Townsville. He also informed the aircraft that in these circumstances an alternate aerodrome would be required for the rest of the flight, and that for this purpose both Townsville and Rockhampton were suitable.

At Rockhampton Capt. Pollard was informed that there would probably be fog

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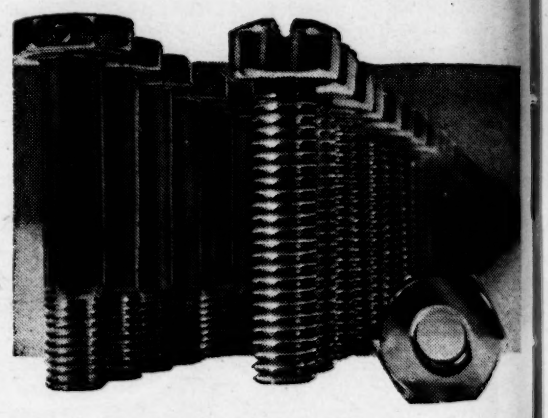

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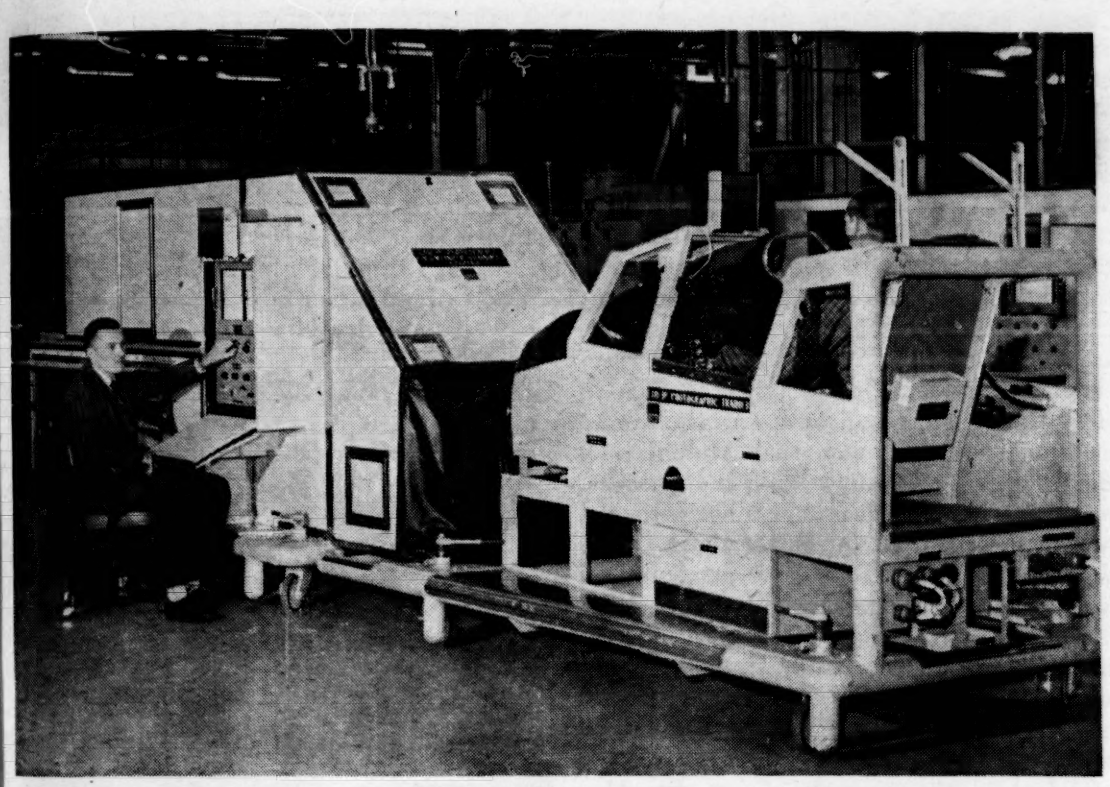

Vought Builds Photo-Plane Trainer

Photo-reconnaissance plane simulator, designed and built by Chance Vought's Aeronautics Division, is programed and free to move in four directions, while giving pilot-student a realistic over-the-ground moving image of his camera targets. Through a lens and mirror system, various aerial photo images and flight paths are presented to the simulator pilot as he would see them from an actual jet photo-plane traveling at 10,000 ft. or 30,000 ft. and at speeds of 200 kt. to 600 kt. and wind velocities up to 60 kt. from any direction. Terrain and targets would cover a 150-mi.-square area. Although designed to supplement existing Chance Vought F8U-1P Crusader photo-plane cockpit and camera trainers, the trainer shown can also be used in conjunction with training for other types of aircraft. Aeronautics Division is scheduled to make initial deliveries to Navy this month.

on arrival at Mackay and that the airport could be closed for landings. The captain made an inquiry about accommodation at Rockhampton and was informed it might be a bit hard to arrange.

At Rockhampton 21 passengers with baggage, mail and freight were discharged and 16 passengers for Mackay were taken on together with baggage, mail and freight. The aircraft was refueled at Rockhampton. At first, 450 gal. were taken aboard, but after the passengers had been embarked a further 100 gal. were added. The aircraft then had 700 gal. on board, making its endurance 260 min. This was sufficient to provide a reserve of 208 min. after the flight to Mackay, the flight time from Rockhampton to Mackay being 52 min. The takeoff weight at Rockhampton was 35,275 lb. as against a maximum permissible takeoff weight of 36,225 lb. The position of the center of gravity of the aircraft was satisfactory on leaving Rockhampton.

While the aircraft was on the ground at Rockhampton at 7:40 p. m., the air traffic controller at Mackay issued a second special weather report dealing with the presence of fog in which visibility was said to be fluctuating.

The aircraft departed from Rockhampton at 7:52 p. m. Capt. Pollard was then occupying the left hand, or port side, seat. The departure from Rockhampton was quite normal and was reported to the air traffic controller at Mackay at 7:53 p. m. He was also advised that the expected flight time to Mackay was 52 min. at a flight level of 13,000 ft., that Capt. Pollard had selected Townsville as his alternate, and that his expected flight time from Mackay to Townsville was 55 min. The aircraft carried sufficient fuel (in addition to reserves) for these operations and for 100 min. holding flight at Mackay, if necessary.

At 8:17 p. m. the aircraft reported at the prescribed reporting point, Charon Point, some 80 mi. south of Mackay, at a flight level of 13,000 ft., and gave its estimated time of arrival at Mackay as 8:40 p. m. The aircraft was advised that the Mackay Airport was closed to landings at that time and the situation remained the same when the aircraft reached the point at which it would normally have commenced its descent to Mackay. Capt. Pollard indicated that he would continue the flight at 13,000 ft. and hold over Mackay at that altitude.

At 8:40 p. m. the aircraft reported that it was over the top of Mackay, and in reply to a request by Eugene William Anthony Miskell, the Air Traffic Control Officer there, the pilot advised that at that time he had at least fuel sufficient for 100 min. for holding over Mackay. Although Miskell believes that communications between himself and the aircraft over Mackay were with Pollard, the evidence does not enable me to reach a firm conclusion in that regard. Therefore, in relation to the aircraft, I attribute such communications to "the pilot" meaning thereby either the captain or the first officer.

At 8:45 p. m. Miskell advised the pilot that visibility was fluctuating between 2 and 2½ mi. along Runway 14–32. The pilot replied that the airport lighting, the city area, and the surrounding country could be clearly seen, but that a belt of fog extending about 10 mi. was situated to the southwest of the airport and was moving in a slightly northeasterly direction

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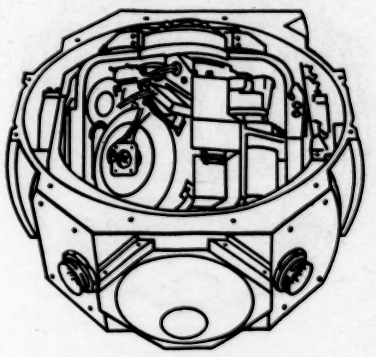

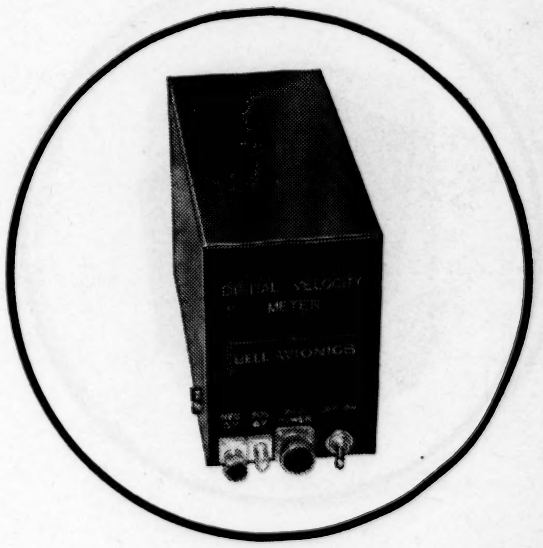

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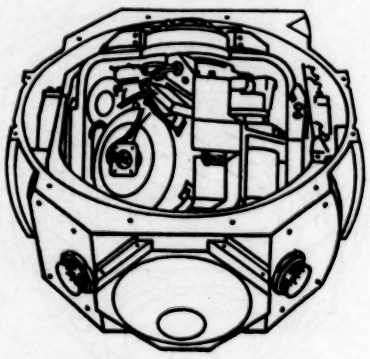

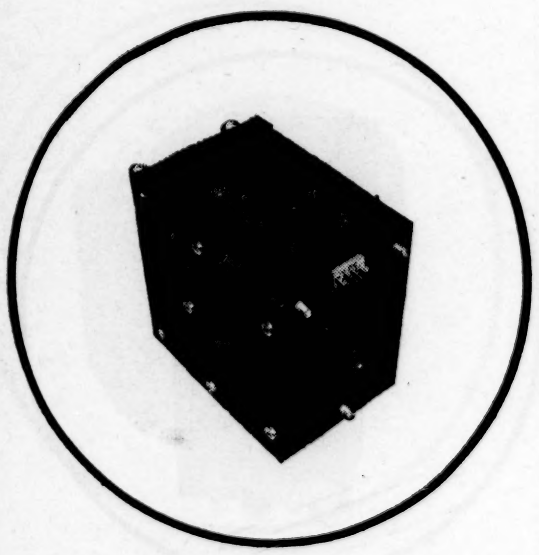

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across the airport. The pilot then requested landing instructions.

The aircraft was cleared to make a visual approach with a view to landing on Runway 14. The pilot was provided with details of wind velocity, QNH (pressure for altimeter setting) and the dry bulb temperature. The pilot was requested to report final approach. The pilot acknowledged the instructions, reported that he was on final approach and at 8:55 p. m. the aircraft was cleared to land. The aircraft was then in sight from the control tower and the visibility appeared to be such that Miskell fully expected that a landing would be made.

As the aircraft approached close to the runway threshold at a height of about 50 ft., the pilot advised that a small patch of fog had suddenly appeared on the approach to the runway. It then flew along the runway at a height of approximately 50 ft. and commenced to climb away. The pilot advised that he would look at the approach to Runway 32 which is the same runway approached in the opposite direction. The failure to land in the circumstances was a completely normal procedure having regard to the conditions which prevailed. Any ground fog at low level along the line of the runway might appear much more of a hazard to the pilot than to Miskell who viewed the area from a different angle.

Miskell did observe that the lights of the aircraft went slightly hazy as it broke off the approach. Miskell next observed the aircraft descending to approach Runway 32. It reached a height of approximately 200 ft., but before crossing the threshold commenced to climb along the line of the runway and the pilot requested permission to hold over Mackay at 5,000 ft. until an improvement in the weather occurred. This procedure was approved by Miskell. The aircraft continued to hold over Mackay until about 10 p. m. Throughout the intervening period there were frequent exchanges of information between the pilot and Miskell as to fog patches. From the airport it was observed that during this time visibility fluctuated between 3 mi. and 400 yards. At 9:40 p. m. it was reported by the pilot that the fog was clearing and it was estimated that it should be clear of the field in about 20 min.

Shortly before 10 p. m. Miskell observed that the visibility was 2½ to 3 mi. to the southeast, and that at about 2 to 2½ mi. to the northwest the fog was thinning and lifting. He reported to the pilot that the fog appeared to be breaking up. The pilot reported at about the same time that the fog was moving over the airport and away to the northeast.

The period between shortly before 10 p. m. and 10:05 p. m. is of crucial importance in determining the course followed by the aircraft in that period, and it is necessary to examine the evidence in some detail. Miskell's account is that at approximately a minute to 10 p. m. it appeared to him the fog was breaking up, and he informed the pilot accordingly. The pilot replied that it still looked pretty thick over the field to him. At 10 p. m. Miskell says he observed the visibility was 2½ to 3 mi. to the southeast and 2 to 2½ mi. to the northwest.

His evidence then proceeds as follows. (Answers are in boldface type):

"Mr. Lucas: And the fog was thinning and lifting?—**That is correct.**

Was the visibility as good then as when you had given his clearance to land at 2045 hr.? I suppose your reply would be that it was above the minima in each case?—**Yes, that is so.**

Then I think you observed some cloud?—**Yes, I observed some stratus forming.**

Will you describe stratus cloud for the benefit of the Board?—**Stratus means actually layer cloud, thin sheet; it is low level cloud when it is used as the term 'stratus' only and it can be formed from 50, 100, 1000, 2000, 3000 ft.—it is not much higher than five.**

Mr. Lucas: And this particular stratus—you made an estimate of its base?—**Between 500 and 1000 ft.**

You passed that information about that stratus to the aircraft?—**I did.**

What was his reply?—**He said, if I can remember—I cannot remember the exact words—he said 'Roger tower, I can see now it is moving over you to the northeast. I will commence to let down for Runway 32 now.'**

At about 2202 hr. I think you noted that conditions improved rapidly?—**That is so.**

And the visibility then would be better than it had been two minutes before?—**It certainly was continually improving.**

When you informed the aircraft of that, that is when he made that transmission you described a moment ago 'Roger tower, will commence let down to approach on Runway 32'?—**Yes.**

You cleared him to make a visual approach?—**Yes.**

You gave him the usual transmission—the wind, calm; QNH? Do you remember what the QNH was?—**1019 millibars.**

And you requested him to report on final?—**Yes.**

Did the aircraft ask for a check on the QNH?—**Yes.**

Do you remember your words in reply to that transmission?—**'QNH is 1019 millibars.'**

Did the aircraft acknowledge?—**'Tango Foxtrot Bravo.'**

His Honour: What time was that?—I am **not too sure of the precise time; between two minutes past—shortly after two minutes past or right on two minutes past. That time of 02 can only be deduced by the length of conversation I thought I had with the pilot from on the hour; and the weather information passed to him and his acknowledgment of same—his intention to commence to let down; my clearance for him to do so, and this check back on the QNH would occur, with our method of speaking, in a fairly relatively short time.**

In substance that was all one conversation?—**A continuation; just going along.**

Mr. Lucas: Could you distinguish which of the two pilots you were speaking to during the course of that transmission?—**To the best of my knowledge it was Capt. Pollard.**

Your next action I think was to ring up to the fire crew to confirm the current dry bulb temperature?—**Yes.**

It is normal procedure to give the dry bulb temperature as part of the information to the aircraft when you are clearing it to make an approach?—**Yes.**

Mr. Lucas: What was the reason it was

not given on this occasion?—**I had previously been given the dry bulb—the dry bulb had been passed to me from the fire crew about 10 min. before this descent commenced and I wanted to check back on the figures I had received from the fire station.**

His Honour: This is in fact all part of the process of this conversation—this intermittent conversation you were having?—**No. This is after we had finished speaking.**

Then you immediately went to get the dry bulb temperature?—**Yes. I then made progress to get that information.**

Mr. Lucas: What is your means of communication with the fire crew?—**We may use the radio but it not usually done unless the matter is really important, so the usual communication is through the PABX system, through the telephone on the console.**

Is that a direct line or—?—**Yes, just dial two numbers.**

His Honour: You get direct contact?—**Yes, immediate.**

Mr. Lucas: And the dry bulb was confirmed as 13 deg. centigrade?—**That is correct.**

What action did you take on that confirmation?—**I then passed that information to the aircraft.**

Can you recall your words?—**'Tango Foxtrot Bravo,—dry bulb is 13 deg.'**

There was no acknowledgment of that?—**No.**

His Honour: Can you indicate what time you think that was?—**I cannot be sure. No, I know. But I would say about 4 min. past or 4½ min. past. Things worked very rapidly. If I take it from the time that I passed it the second time, and just allowing him time to acknowledge in between, it would come back to about 4½ min. past the hour —to 4 min.**

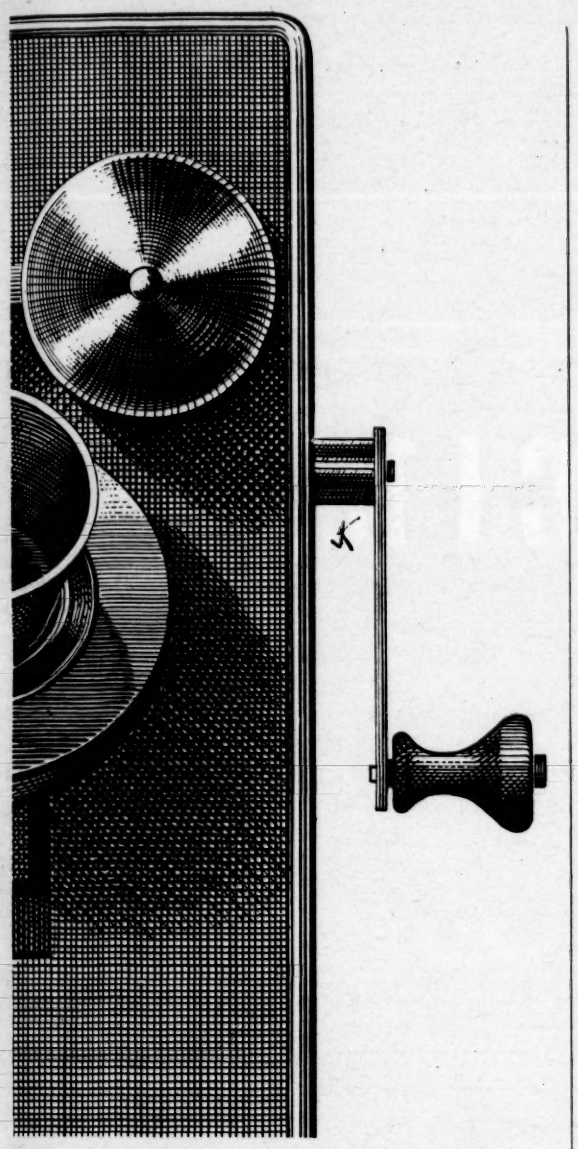
Mr. Lucas: I want you, Mr. Miskell, to try to do the best you can to make a very careful estimate of the time between the aircraft's acknowledgment of your check of the QNH and the time of your transmission of the dry bulb temperature?—**To the best of my knowledge, and having given this matter a lot of careful thought because I realize how critical this time factor is to the Board, there are only two times I was positively sure of. One was on the hour and the other was 5 min. past. It appeared to me to be a very short time from the time I cleared the aircraft, or we agreed on to clearance, until I lost communication. It just appeared to be a short time to me—3 min., 3½ min.; that is the impression it has given me all along—not 5 or 6 min. or 7, but a short time, within that 5 min.—about 3 min. That is only an assumption.**

Mr. Lucas: That is the best you are able to do?—**Yes. There was no reason at that time for me to remember precisely that information.**

His Honour: Don't think anyone is criticising you, in not remembering it precisely. —**No.**

Mr. Lucas: I think you made an entry in your log to declare loss of communication? I am sorry. I am reminded that after you had passed the dry bulb and had received no acknowledgment, you looked at the clock?—**I passed the dry bulb, received no acknowledgment, I passed it again and on receiving still no reply I then looked at the clock. It was 05 and I logged that time."**

Miskell's Air Traffic Control Journal con-



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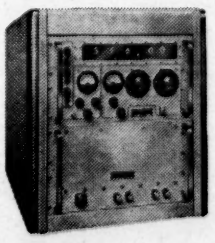

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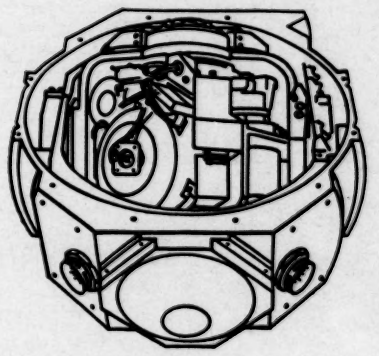

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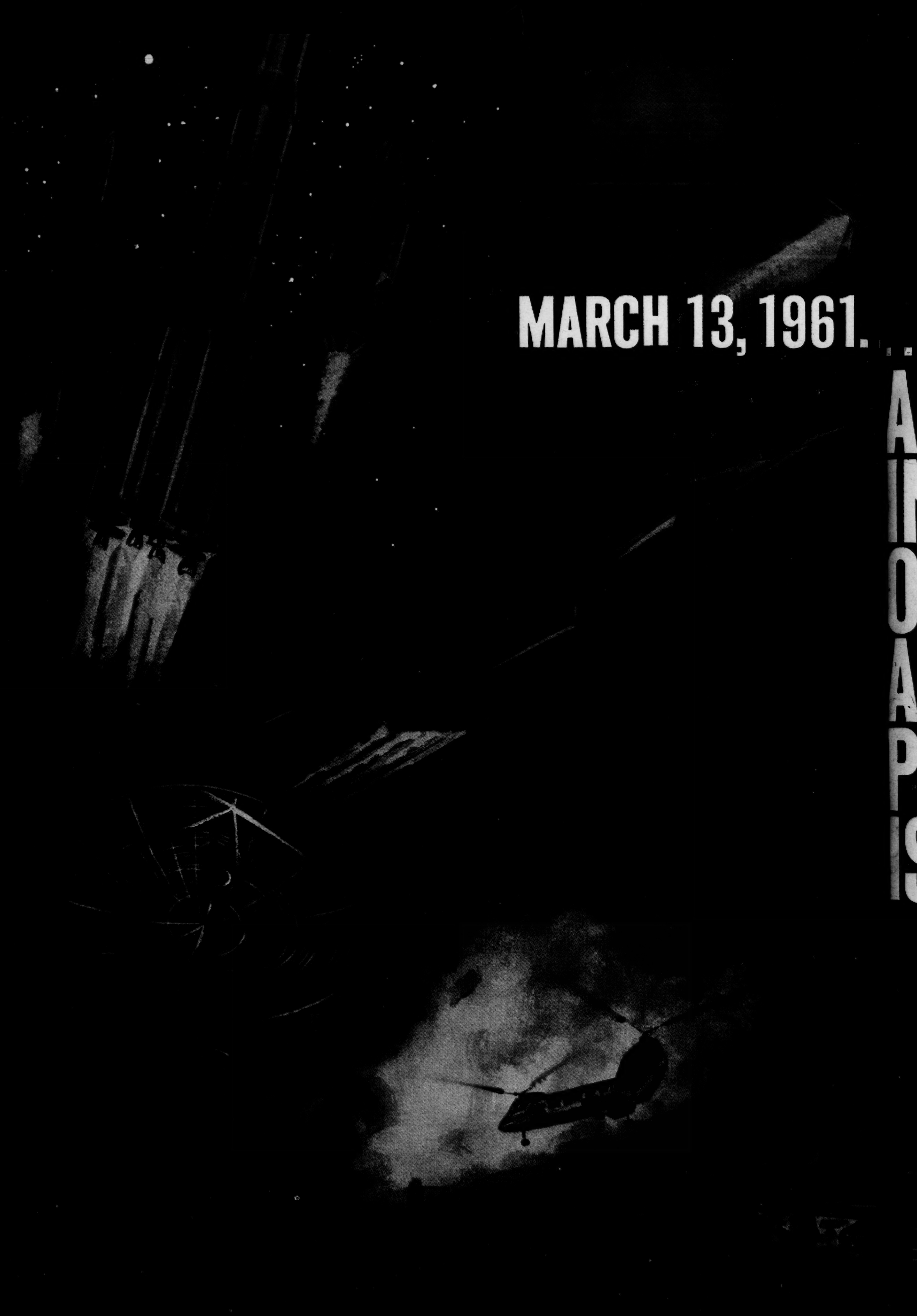
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tains the following entries made after he lost contact with the aircraft:

"1205: TFB advised will let down for approach R/W 14/32. Vis. 2½–3 mi. to SE. Fog dispersing.

"1210: Distress Phase declared at 1210. Nil QSO VH-TFB Last heard on 118.1 at 1205."

The times shown in the journal are Greenwich Mean Times corresponding with 10:05 p. m. and 10:10 p. m. Eastern Standard Time.

Log Entry

At the time when the pilot advised he would let down for approach Miskell did not make an entry in the log to that effect. Believing that the aircraft was about to land he not unnaturally made an entry "Off duty" and attached his signature thereto. To that entry, I think, he attributed the time 1205 which would be about the time when the aircraft would land. When he lost contact he rubbed out the entry "Off duty" and substituted the entry which now appears opposite the figures "1205." He did this I think at about the same time as he made the entry opposite the figures "1210."

In my opinion the time properly to be attributed to the first entry is the time when Miskell actually made the entry "Off duty" and this was I believe some minutes before "1205." The making of that entry followed immediately upon the event which is now attributed to "1205." The substituted entry should accordingly be attributed to the time when the first entry was made. I think the same is true of the last sentence of the second entry "last heard on 118.1 at 1205." Miskell was recording that the aircraft had been last heard at the time when the event recorded in his first entry occurred; and as this had been recorded in the log as 1205 it was so attributed to that event in the final entry.

It is only fair to say that at the time these entries were made the circumstances were so serious that the Distress Phase had been declared, and it is not surprising that Miskell in those anxious moments in which he carried a heavy responsibility overlooked that his original entry for 1205 was entered a little in advance of the time when he anticipated he would be off duty.

The time 10:05 p. m. corresponds with the time shown on the starboard clock of the aircraft recovered from the sea. The port clock so recovered indicated 10.07½ hr. The condition of the clocks as recovered suggests that water entered the starboard clock more rapidly than the port clock. I therefore conclude that the impact occurred not later than 10:05 p. m.

The evidence is that the pilot said he would hold at 5,000 ft., and there is no evidence to support a conclusion that he did not hold at that height. As will subsequently appear, the evidence of witnesses who observed the aircraft in the course of its final descent supports the view that there was nothing apparently abnormal in its rate of descent. A descent at a rate of about 1,000 fpm. down to that height from where an approach to land may commence is normal. I think the evidence as a whole justifies the conclusion that the aircraft descended from 5,000 ft. at about that rate.

Miskell's recollection of the times would

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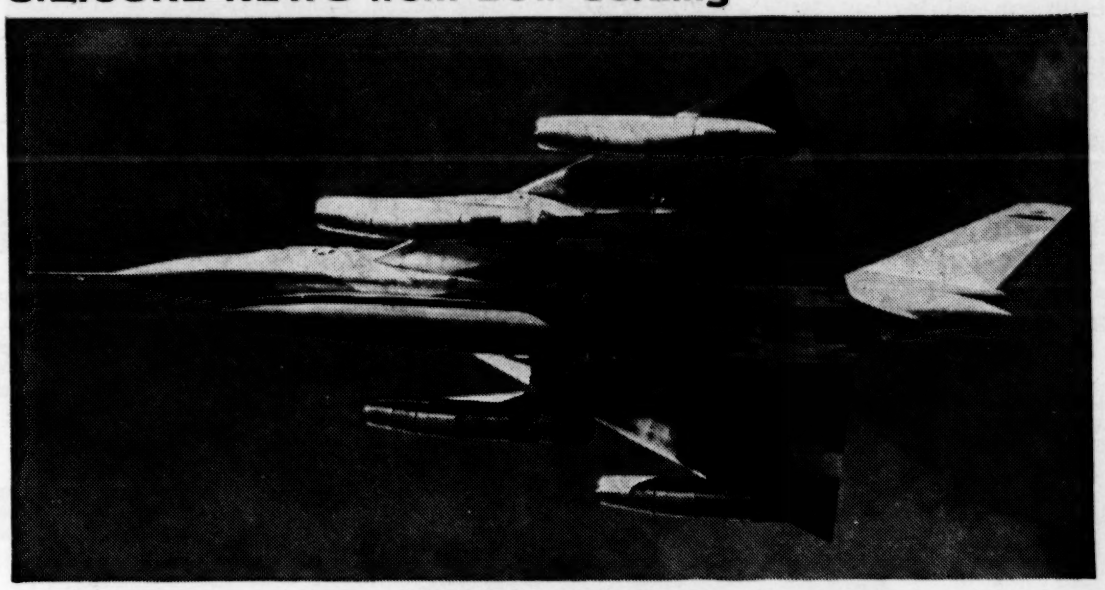

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PROBLEMATICAL RECREATIONS 54

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—Contributed

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ANSWER TO LAST WEEK'S PROBLEM: The journey can be completed by starting it at an infinity of points. One such point is the north pole; all others lie in the neighborhood of the south pole and require one or more complete westward trips about the pole.

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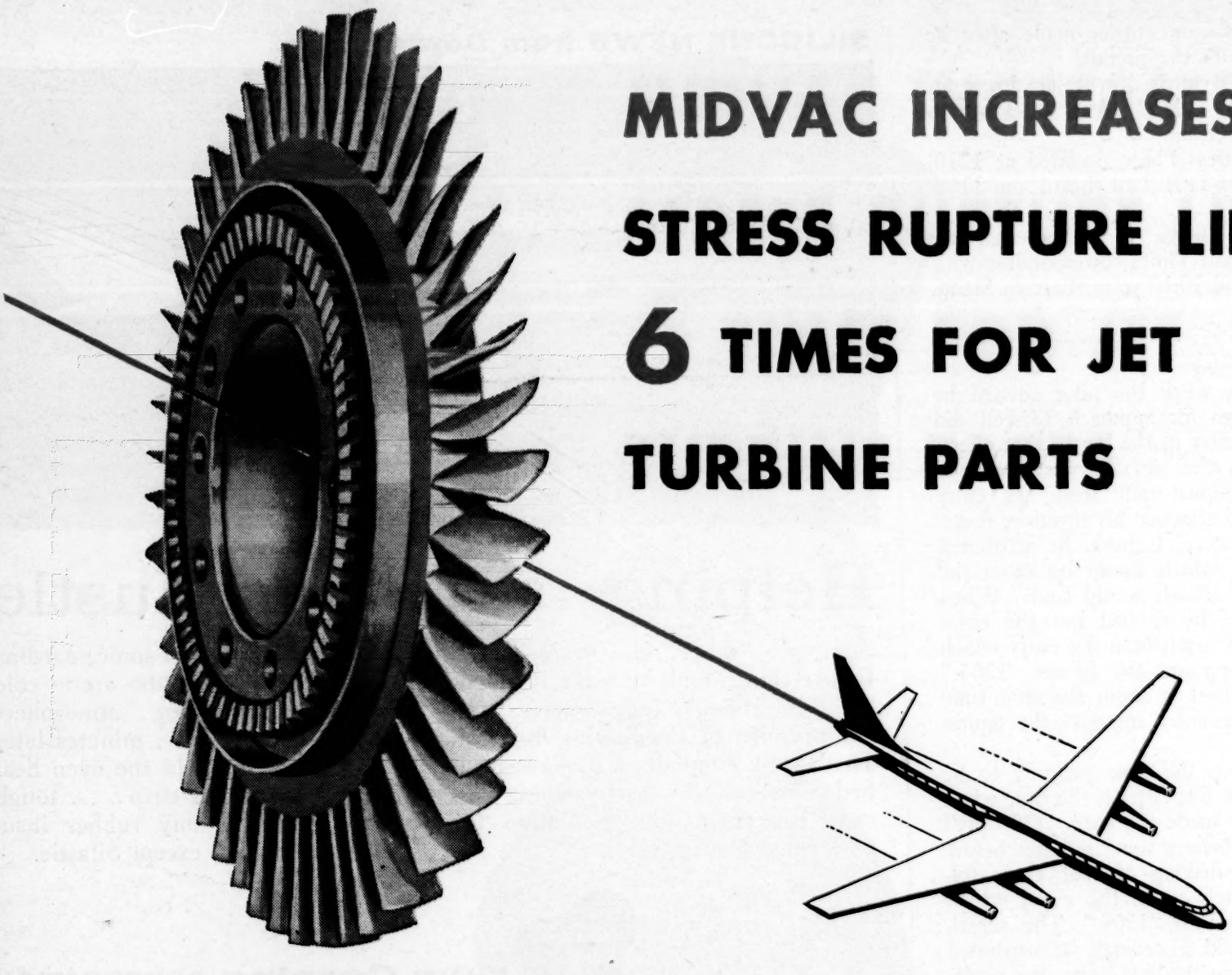

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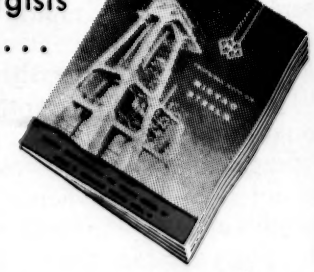

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indicate that the pilot commenced his final descent at about 10:02 p. m. If the aircraft was then at 5,000 ft. the rate of descent was somewhat abnormal and at a figure not consistent with other evidence. I have already stated my conclusion that the evidence does not support the view that the pilot commenced his descent from a lower altitude.

I accept 10:10 p. m. as the time when the Distress Phase was declared, but for the rest, the crucial times given by Miskell are estimates based upon his recollection of events, the precise times of which as they occurred he had no occasion to record, and which in the anxious time which followed he might be unlikely to recall with complete accuracy that night.

It is, I think, a justifiable conclusion from the whole of the evidence, that contact with the pilot prior to the descent was first made shortly before 10 p. m., and that the ensuing conversations prior to the commencement of the descent were more or less continuous and were completed in less time than Miskell was disposed to think. In other words the descent may well have commenced at or shortly after 10 p. m.

Longer Period

There is some evidence to support the view that a somewhat longer period than is suggested by Miskell's evidence ensued between the aircraft's last communication and the ascertainment and transmission of the current dry bulb temperature reading.

At some time close to 10 p. m. there was a telephone conversation between Miskell and one Tindale, the Observer in charge of the Meteorological office at Mackay, maintained by the Commonwealth Bureau of Meteorology. Tindale rang Miskell to enquire if any aircraft were coming in, and was informed by Miskell that there was one "over the top now coming in." Tindale was unable to say whether this conversation occurred before or after 10 p. m. and Miskell was unable to remember whether it was before or after the aircraft's final communication. The expression "coming in" suggests it was after that event, and my conclusion is that it occurred between then and the transmission of the dry bulb temperature reading.

Maddison, the Traffic Officer employed by Trans-Australia Airlines at Mackay, was in the control tower at the relevant time. His estimate of the time which elapsed between the aircraft's last acknowledgment and the transmission of dry bulb reading was "say a little bit over a minute. It was in the vicinity of a minute." Maddison also placed the time of the conversation with the pilot when he intimated that conditions did not look as good to him at "about five minutes to ten."

In this state of the evidence the only conclusion one can properly reach is that the accident occurred at about 10:05 p. m. and that the aircraft had descended from its holding altitude to sea level within a period of 5 min.

It has been established to my satisfaction that at all relevant times all the radio navigational aids and airport lighting facilities were functioning satisfactorily.

I have no hesitation in finding that Miskell, the Air Controller at Mackay, properly performed all his duties in relation to the aircraft, and is entirely free of any blame or suspicion of blame in relation to the accident. From the time the aircraft came within his area of control he acted in accordance with the obligations imposed on him as air controller, and in particular in the conditions which existed at about 10 p. m. he was justified in giving a clearance to the aircraft to make a visual approach. At 10:10 p. m. with commendable promptitude he declared the Distress Phase of Operations, although under the relevant regulations he might have first declared the Alert Phase. Within the limits of the aircraft's fuel endurance as known to him it was no part of Miskell's function to determine whether or not the aircraft should or should not hold over Mackay, how long it should hold nor whether, when cleared to approach or land, it should in fact proceed to do so. These were matters properly left to the pilot and determined by him.

Miskell continued his efforts to get into touch with the aircraft on all available frequencies and as already appears, at 10:10 p. m. he logged the Distress Phase of Operations. These operations were carried out promptly and efficiently by all concerned. They involved immediate contact by officers of the Department of Civil Aviation with appropriate authorities, and the activities of the Police Force at Mackay, as well as the co-operation extended by citizens of Mackay in search and rescue operations over the ensuing 48 hr., are worthy of the highest commendation.

The main portion of wreckage of the aircraft was subsequently discovered on the sea bed on a true bearing of 154 deg., 5.63 naut. mi. from Flat Top Island. The location was about 7½ mi. from the airport.

Final Course

The holding flight over Mackay, which continued for about an hour, was observed by a number of local residents who were interviewed by members of the investigation team already referred to. Those residents whose observations proved useful in determining the course flown by the aircraft in its final descent gave evidence at the sittings of the Board at Mackay. From this and other evidence it became possible for the investigation team to plot with some degree of accuracy the course taken by the aircraft in its final descent.

The assumed course so plotted involves certain assumptions as to the height from which the final descent was commenced, as well as the speed of the aircraft and its rate of descent. The assumptions so made are, I think, consistent with the evidence which is available, including conclusions to be drawn from the examination of the wreckage to which reference is made hereafter. Different assumptions as to any of these factors would alter the precise course shown in the appendix. The evidence, however, supports the view that the aircraft followed a course of the character shown in the appendix on its final descent. It further indicates that with the exception of one witness nothing abnormal was observed prior to the disappearance of the aircraft.

One woman testified to having seen what she described as a "red glow." Her husband, who was with her at the time, did not see this glow, although it may be that his attention was not directed to the aircraft at the same moment as that to which the woman was testifying. Other witnesses in an equally good position to observe such a phenomenon did not testify as to its presence. I think what the witness described as a red glow may have resulted from an impression created by a particularly clear view of the rotating red beacon on the aircraft which she had seen previously. There is no evidence in my opinion to support any conclusion that the descent into the sea was preceded by any signs of fire or explosion. On the contrary the evidence supports the view that the descent was the regular descent of an aircraft in the vicinity of an airfield on which it was proposed to land.

However, it does appear that the aircraft was as low as 500 ft. when observed flying over the water within a minute or so of the accident. All this points to the conclusion that the cause of the accident is to be found, if at all, in something that occurred within the last two or three minutes of the flight.

Alleged Irregularities

At this stage of the report it is convenient to refer to certain alleged irregularities in the operation of the aircraft on June 10, 1960. It is clear that none of the incidents about to be detailed contributed in any way to the accident, but as they have been revealed by the evidence, it is appropriate that I should record them. They are the only incidents revealed, the regularity of which has in any way been questioned.

(1) On the morning of June 10 the aircraft was flown from Mt. Isa to Brisbane via Cloncurry, Winton, Longreach, Blackall and Roma. It had been at Mt. Isa the whole of the previous day. The relevant maintenance manual in operation at the time of the accident contains a document which makes provision for servicing forms and their application. An overnight check is included among the services for which provision is made on page 1 of this document.

The provision reads: "As directed by servicing memo. and before first flight on every occasion when A/C has been inactive for a period of more than 3 days."

On page 3 of the same document there is a table indicating hours when services are due, and in relation to overnight check under the heading "Hours" the phrase "1 calendar day" appears. This suggests that an overnight check was due before the aircraft left Mt. Isa. It is not easy to reconcile this with the provisions for the application of overnight check to be found on page 1. In this regard the document is not free from ambiguity, and since the accident the position has been clarified. A new provision in relation to overnight check provides that an overnight check need not be carried out at the termination of each day's flying where the aircraft is based overnight at a port or base where maintenance personnel are not stationed. No maintenance personnel were stationed at Mt. Isa and therefore under the provisions now operative an overnight check would clearly not be required in the circumstances which existed on the day of the accident. The maintenance required by an overnight check was performed both at Cloncurry and Brisbane and failure to perform the check (if required) at Mt. Isa had no effect upon the airworthiness of the aircraft.

(2) The flight plan prepared in Brisbane to which reference has already been made contains an error in that the addition of the

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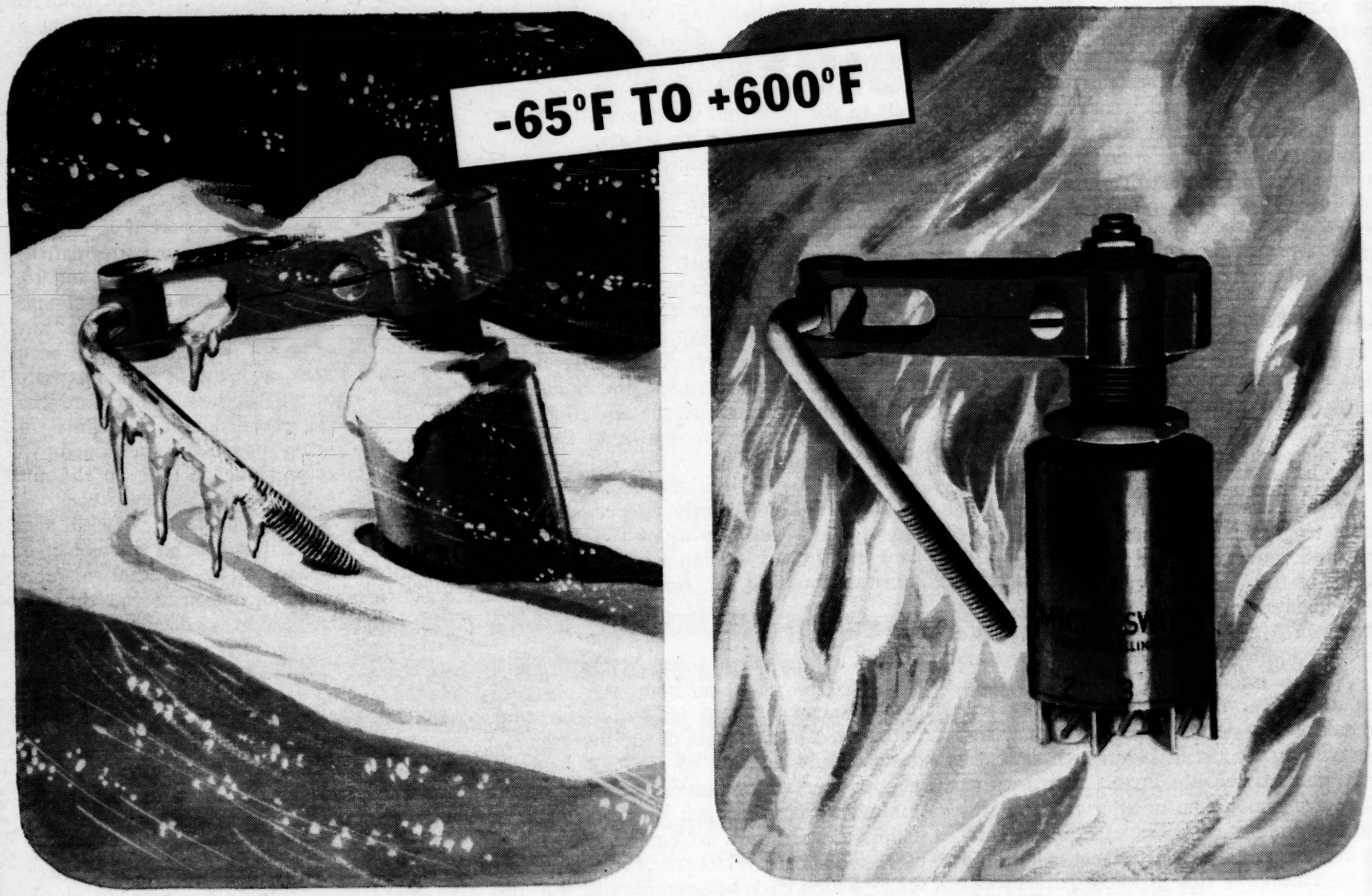

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fuel figures shown in the flight plan appears as 561 gal., whereas the correct addition is 461. This error is obviously only one of addition which was not noticed at the time.

(3) There appears to be an inconsistency between the wind component employed in the flight plan for the stage from Rockhampton to Mackay and the winds for that stage forecast in the meteorological forecast. There are two possible explanations of this. One is that the pilot allowed for a headwind more adverse than forecast, upon the assumption that the winds might be veering round to the northwest in the Rockhampton-Mackay sector as indeed they were in the Mackay-Townsville sector as shown in the forecast. The other explanation is that the pilot, instead of using the forecast winds for the stage Rockhampton to Mackay, in error used the forecast winds for the stage Mackay to Townsville and applied those winds to the stage Rockhampton to Mackay. It is a fact that if the winds forecast from Mackay to Townsville are applied for the stage Rockhampton to Mackay one does arrive at the head wind component of 18 kt. indicated in the flight plan for the section from Rockhampton to Mackay.

(4) While the flight plan was being prepared in the Operations Room at Brisbane, the load sheet was being prepared in the office of Trans-Australia Airlines by one Swanston, dispatch officer on duty. In view of the number of passengers and the amount of freight and mail to be carried on the flight, Swanston calculated that the aircraft could carry a maximum of 2,844 lb. of fuel, or 360 gal., and he accordingly filled in that weight in the load sheet as the weight of fuel. Swanston knew that Pollard wanted to fly through to Rockhampton without refueling at Maryborough, but on Swanston's calculations this could not be done because 460 gal. would be required for that purpose, and only 360 gal. could be properly carried. Swanston instructed one Lawler, an employe of the Caltex Co., the refueling agent, that the fuel of the aircraft was to be brought up to 360 gal.

Payload Reduction

Ten minutes before departure time it was found that 460 gal. could be carried because of a reduction in the payload to be carried. Arrangements were accordingly made that Lawler should put another 100 gal. on the aircraft and this was done. While it was being done another passenger arrived with his baggage and Swanston was forced to make a fresh calculation. This calculation showed that if the extra 100 gal. were added, the aircraft would be over the permitted landing weight at Maryborough, and it was calculated that that weight permitted only 70 gal. instead of the extra 100 which had already been put into the aircraft.

Bishop, the senior dispatch officer at the aircraft, told Capt. Pollard that he was 219 lb. over his permitted landing weight for Maryborough. He replied that he would not worry about having fuel removed as he expected that the consumption on route to Maryborough would exceed the figure stated in the flight plan.

The fact is that the landing weight capacity of the aircraft had been raised beyond that used in Swanston's calculation because of a modification which had been carried out upon it, but the modification to this aircraft had not been approved at that stage by the Department. It therefore appears that the structural strength of the aircraft was in fact such that the extra weight was within its capacity, but the evidence does not disclose whether or not Capt. Pollard knew that the modification had been made on his aircraft.

(5) After leaving Brisbane a message was passed from the aircraft to the Brisbane Area Control Center as follows:

"Set course direct to Maryborough from two zero miles on diversion and our amended endurance ex Brisbane is 245 min. (two hundred and forty five) and we'll be refueling at Rockhampton."

The information in this message was passed from the Area Control Center to the operations room and a fresh endurance of 245 min. was noted on the flight plan. It seems clear that the endurance so noted on the flight plan was incorrect. The aircraft actually carried 460 gal., and it seems likely that the pilot may have intended to indicate that he had fuel for 2 hr. 45 min., or 165 min., which was his original estimate in the flight plan of the amount of fuel required. However, it is usual to transmit such information in terms of minutes. It is possible that the transmission was in some way distorted, although the form of the pilot's message does not suggest this. The message exhibited before the Board is, of course, a transcript of a tape recording.

(6) As already appears, the refueling of the aircraft at Rockhampton was performed in two operations. At first 456 gal. were taken on board, and subsequently another 100 gal. The Trans-Australia Airlines Operations Manual requires a fuel drain check to be performed after each refueling operation in order to determine whether there is any water present in the fuel. This was done after the first refueling and showed that no water was present. However, the drain check was not repeated after the second refueling. The refueling agent suggested a further drain check but the captain said it was unnecessary. The evidence before the Board establishes that the fuel in both operations came from the same batch. On June 11, 1960, a water check was carried out on the tanker from which the fuel had been supplied and it showed an entire absence of any water. It seems clear, therefore, that all the fuel taken on at Rockhampton was free of any water.

Soon after the accident the services of the Royal Australian Navy were offered to the Department of Civil Aviation to undertake the salvage of aircraft wreckage from the sea bed. This offer was accepted and HMAS Warrego was engaged on this work from June 12 to 27, and HMAS Kimbla from June 17 to 27. A team of specialist divers from the Clearance Diving School, RAN, Sydney, was flown to Mackay to join HMAS Warrego for the purpose of leading the diving activities conducted in conjunction with the ship's divers. The work was conducted with great care and skill and a very large percentage of wreckage was successfully recovered.

It is the view of the Director of Air Safety Investigation that the portions not

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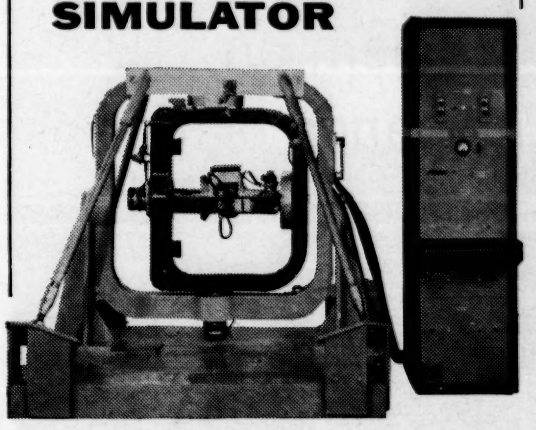

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recovered appear to have no significant bearing on the cause of the accident.

Under the skilful direction of Mr. C. A. J. Lum, the Director of Air Safety Investigation, the work of establishing, collecting and collating facts from the examination of the wreckage and the study of testimonies of witnesses was performed by arranging the investigating team into working groups comprising the appropriate specialists and experts from the Department of Civil Aviation and Trans-Australia Airlines.

Each group received assistance as required from technical experts from the aircraft and engine manufacturers and from scientific or technical organizations by way of reports on specific examination of materials or components taken from the wreckage. The examination of wreckage was extremely thorough and the investigations extended from June 11 almost up to the date of the commencement of this inquiry.

The Board has had the advantage of having had submitted to it the complete report of this investigation, and from that material and the evidence of witnesses concerned in the investigation, it is possible to reach a number of conclusions in relation to the probable course followed by the aircraft prior to impact and as to the condition of the aircraft at the time of impact.

Engine Controls

The first of these is that the powerplant controls appear to have been fully serviceable before the impact and the engines appear to have been under power at the moment of impact. It seems likely that the engines were operating at or about 10,400 rpm.

The examination of the propeller mechanisms disclosed that at the time of impact the angle of the blades was 33¾ deg. This supports the view that the aircraft at the moment of impact was traveling at a speed of not less than 160 kt.; 10,400 rpm. would produce such a speed with the blades at such an angle. Some further indication of the minimum forward velocity was provided by the experts who examined the aircraft's structure. Their view was that the forward velocity would have been not less than 120 kt. This is not inconsistent with the deduction drawn from examination of the propeller mechanisms.

From the evidence of those who examined the aircraft's structure it may be deduced that the aircraft probably struck the water in a flat attitude between 5 deg. nose up and 5 deg. nose down, and banked to starboard at an angle of between 5 deg. and 10 deg. This deduction is consistent with the character of the final descent as observed by those who witnessed it. Examination of the structure also led to the conclusion that the descent had been at not less than 900 fpm.

Examination of the flight control systems indicated nothing to suggest that any part of those systems was not functioning correctly prior to the accident. It seems that at the time of impact the flaps were in the fully retracted position. The same conclusion was reached in relation to the landing gear. Examination of the fuel, water methanol, pneumatic, oxygen, fire protection, anti-atmospheric, de-icing, pressurization and air conditioning systems led to the conclusion that they were fully serviceable with the exception of insignificant items to which reference will be made hereafter.

The expert who was responsible for the examination of the electrical equipment found no evidence that any of the electrical systems was not functioning correctly at the moment of impact. Indeed he was of opinion that there was positive evidence that the systems were functioning since so many circuit breakers were tripped. He maintained that electrical power must be applied to the circuits before the circuit breakers could trip. He considered it was impossible that the circuit breakers would have been tripped before the impact.

One feature of this expert's evidence raises a matter of concern. It was found that the emergency inverter switch was on, and his opinion was that it had probably been deliberately switched on before the impact and not knocked on by forces generated by the impact. The emergency inverter provides an emergency power supply to some of the instruments on the captain's, or port side of the aircraft, and if it were on before impact it would suggest that the captain became aware of an emergency before the aircraft hit the water. It cannot, however, be determined with certainty that the emergency inverter was not switched on as a result of the impact and the damage which followed it. Observation of some of the relevant damage supports this latter possibility.

An examination of the instruments revealed that the starboard clock stopped at 1005 hr., and the port clock at 1007½ hr. I have already indicated my view that the time shown on the starboard clock indicates with relative accuracy the time of the impact.

The altimeters on examination disclosed that the port altimeter read 1,160 ft., and the starboard 7,800 ft. In view of the fact that the aircraft appears to have hit the water at a time when one would have expected its altitude to have been about 1,200 ft., it might be thought that the reading on the port altimeter is of some significance. I am satisfied that it is not because of the expert evidence which has been given, the extensive damage to the mechanisms, and the very marked difference in the readings of the two altimeters. It appears that both altimeters had been accurately set to a barometric setting of 1,019 millibars which, it will be remembered, was the barometric pressure reading passed to the aircraft immediately before the accident.

Plane Heading

From the radio magnetic indicators it was possible to deduce that at the time of impact the heading of the aircraft was between 255 and 260 deg. Both the port and starboard static systems were selected to their normal static sources. Apart from certain abnormal dips and bends in both port and starboard pitot static lines to which reference is made hereafter, all damage to that system was consistent with forces generated by the impact. There is no evidence to indicate any malfunctioning of any of the instruments examined.

The condition of the cockpit revealed a somewhat remarkable set of circumstances in that a number of the services for the

port side facilities was found to be switched off and a number on the starboard was found to be switched on. This was so in relation to the electrical power generators, the pitot heaters, fuel filter heaters, and the engine intake, propeller, and wing air intake de-icing. It is not possible to reach any firm conclusion as to whether this state of affairs was brought into being before the accident or as the result of forces generated by and after the impact. One suggestion was that, as on this flight the first officer was to undergo a proficiency check, the captain, in the course of the final descent, asked him to assume some emergency and to carry out the operation to the point of moving the switches. It would be contrary to the usual practice, if such an exercise were in operation, that the captain would require the first officer to go to the length of activating the switches. Furthermore, the position of the switches as found does not conform to any known emergency procedure.

The examination of the wreckage supports conclusions reached by the Director of Air Safety Investigation in his report. He said (inter alia):

- "**No evidence was found** of material or structural defects having existed prior to the accident and all damage evident to the structure of the aircraft can be attributed to forces generated by impact with the water." It may further be stated that such damage is not consistent with any other cause.
- "**There were only three items** of minor unserviceability discovered in the wreckage. All other damage or abnormalities relating to the aircraft systems has been attributed to the forces involved in the impact."

The three items of minor unserviceability to which reference is here made are:

- **One of the two** 3/16 in. diameter bolts securing the down lock limit stop on the port main landing gear was sheared, probably as the result of being overtightened during maintenance. This appeared to have no adverse affect on the serviceability of the unit.
- **A bolt** $\frac{1}{8}$ **in. in diameter** and $\frac{5}{8}$ in. in length was found in the body of the drain valve of the port fuel tank. Its only significance is in relation to an incident at Rockhampton where the port drain valve stuck open during refueling operations and two gallons of fuel drained from the tank before the valve was reseated. It is clear the valve was seated properly at the time of the accident.
- **A pipe** $\frac{1}{8}$ **in. in diameter** which connects the blower duct and the pressure transmitter in the air conditioning system on the port side was found to be fractured adjacent to the transmitter. Even if this fracture occurred prior to the accident it had no effect on the safe operation of the aircraft.

There was one abnormality, namely certain dips and bends in the pitot static systems which cannot be attributed to forces involved in the impact. These receive further consideration hereafter.

There was no evidence of fire or explosion having occurred at any time prior to or subsequent to the impact. This conclusion is consistent with the observations of those who witnessed the final stages of the flight.

There was no evidence of any commotion or unusual act by any person having taken place within the aircraft at any time.

The only circumstances which might have created a suspicion of any unusual conduct by any person related to a passenger who embarked on the aircraft at Rockhampton. He was a citizen of the United States. The taxi driver who brought this passenger, along with others, to the aerodrome at Rockhampton, gave evidence of somewhat irrational conversation in which the passenger engaged. This led to inquiries being made in America as to whether he was a person who might possibly conduct himself in some manner prejudicial to the safety of the aircraft and its occupants. I am quite satisfied on the material which has come from America that there are no grounds for suspecting that any conduct of this passenger on the aircraft contributed in any way to the accident.

Indeed, I think there is positive evidence that at least up until the time when the aircraft was given its clearance to make the final descent everything was normal and peaceful. This is provided by a letter written by Air Hostess June Hamilton which was recovered from the wreckage. The letter is as follows:

"Dear Mona,

At present we are trying to get into Mackay—fog—viz ½ mile. On Tuesday we have to have our injections at 12:30 in town. Margaret Hitchcock has asked us to dinner Tuesday night, she is also lending me a cabin trunk so I can put all my sheets—summer clothes—books etc. (things I won't need for awhile) and can leave it in Sydney until I need them.

We'll have accommodation in ML, probably at Chevron and we crew 453 down on Monday.

Nellie & I are going to ML together on Sunday—isn't that beaut. Joy doesn't want to leave the house now so we are still looking for 2 more girls. As you can see I have a lot to tell you.

Hurry home—we are going to get into Mackay at last. See you tomorrow night (I'm writing this on Friday).

Love June x"

The reference to the fact that the aircraft was "going to get into Mackay at last" seems to me to indicate that the letter was written during the holding flight and not prior to the earlier abortive attempt to land and was completed toward the end of the holding flight.

In the course of the investigation of the wreckage the emergency inverter was found switched on. Consequently the possibility of some sudden but undiscovered emergency having arisen in the last moments of the flight cannot be entirely dismissed.

One other circumstance which lends support to this possibility is the fact to which reference has already been made that certain port side services were found switched off and corresponding services on the starboard side switched on. This condition of the cockpit facilities is of course of no significance if, as seems probable, it arose from the impact.

However the possibility that this condition existed prior to impact cannot be entirely excluded. If it did so exist it may indicate no more than action taken in

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relation to an assumed emergency in the course of the first officer's check flight. The elements which weigh against this explanation are the probability that the captain was flying the aircraft at the time, and the unlikelihood that in any event the switches would in fact be activated in the course of a simulated emergency. If therefore, the port side services were switched off before impact, this would suggest something unusual.

It may be that something unusual did occur which a most thorough examination of all apparent possibilities has failed to disclose.

(Conclusion of the safety report will appear in a subsequent issue of AVIATION WEEK*—Ed.)*

FAA Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by the Federal Aviation Agency:

Columbus Electronics Corp., Yonkers, N. Y., contract FA-1916 (1-1177B1), transmitter, UHF, ground air, 20 watt, 300 ea., spare parts, set for use with above item, 30 sets, preparing and furnishing replaceable parts list for item, one list, item identifications for replaceable parts for item, estimated 85 ea., $184,220.

Bridge Electronics Co., Inc., Beverly, N. J., contract FA-1918 (1-1184B1), telegraph distortion analyzer, Bridge Electronics Co., Inc., Model ASD-100, 106 ea., preparing and furnishing replaceable parts list for item, 1 list, item identifications for replaceable parts for item, estimated 50 ea., $38,673.

ITI Electronics, Inc., Clifton, N. J., contract FA-1925 (1-1214B1), L/MF range monitor receiver, portable, 120 ea., spare parts set for use with item, 10 sets, preparing and furnishing replacebale parts list for item, 1 list, item identification for replaceable parts for item, estimated 25 ea., $26,317.

Westinghouse Electric Corp., Washington, D. C., contract FA-1027 (1-3093B1), top assembly for flush marker type 1-B with short base, type HL, fixture, Westinghouse model consisting of the following: lampholders, breakable coupling, film cutout, lens, deg. filters, single and double marker lights, relays, transformers, brightness control assembly, motor, wind sock only (nylon) and coils, various items and quantities, additional charge for preservation and export packing, entire job, $33,893.

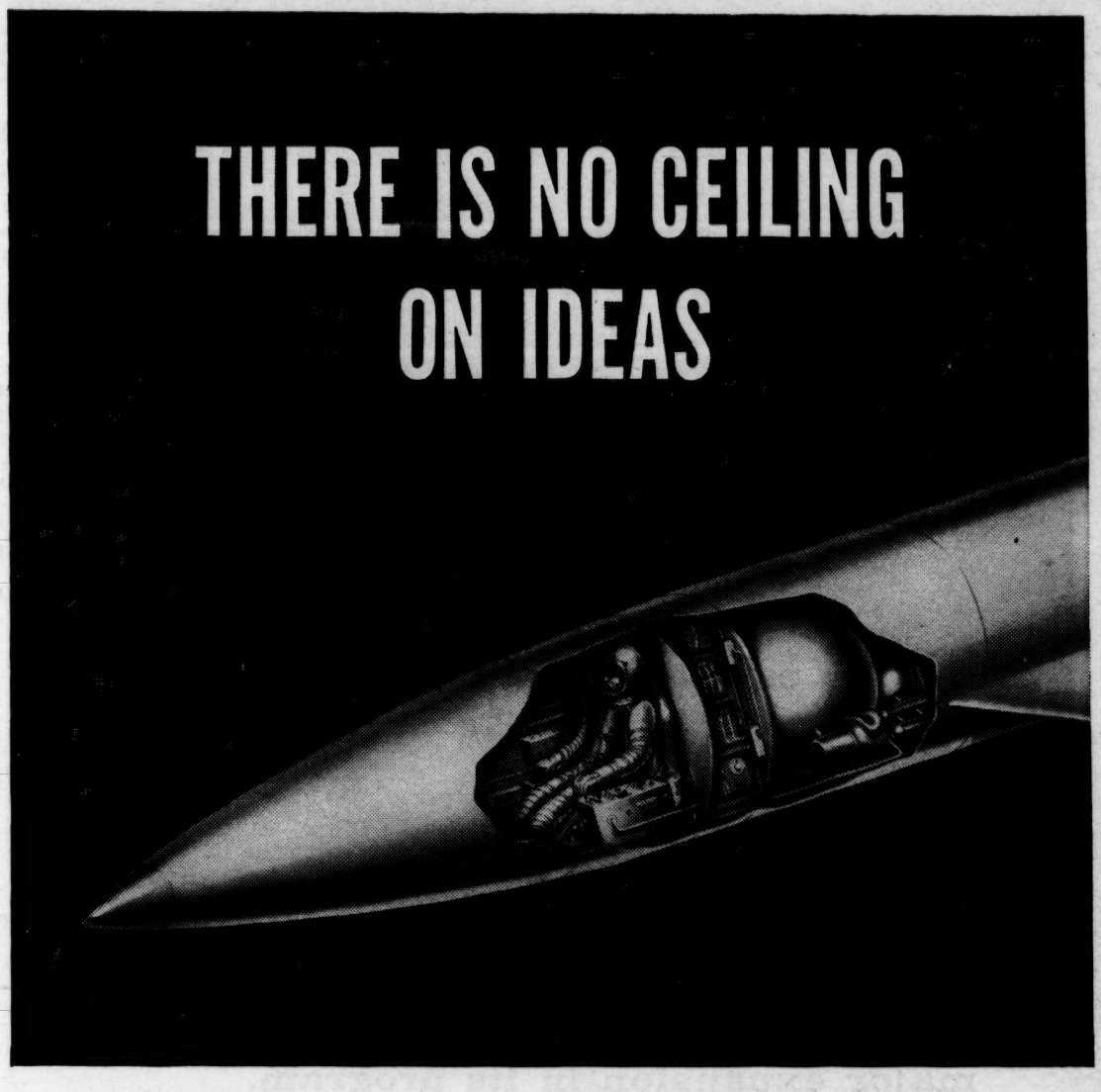
Bagwell General Steel Co., Sapulpa, Okla., contract FA-1908 (1-3106B1), tank, fuel storage, 515 gal. capacity, 220 ea., 1,000 gal. capacity, 55 ea., 2,000 gal. capacity, 10 ea., $26,895.

Arlington Asphalt Co. and Corson & Gruman, Inc., Arlington, Va., contract FA-NA-59, furnishing all paint materials, equipment, tools, labor and transportation (including fuel, power and water) and performing all work required to construct new taxiway, widen the existing apron area, overlay parts of the existing paved areas, new drainage areas, new drainage facilities and modification of taxiway lighting system at the Washington National Airport and perform all associated work, $1,351,748.

Teletype Corp., Skokie, Ill., contract FA-1743(1-1016B1), area center equipment (control), three systems, area center equipment (non-control), seven systems, $887,137.

Indiana Steel Tank Corp., Gary, Ind., contract FA-1934(1-3098B1), reflector, passive, aluminum, for RML tower, knocked down type, 45 deg. slope, solid face, complete with mounting hardware, 10'x15', 20 ea. and 8'x12', 374 ea., $109,111.

Edwin L. Wiegand Co., Pittsburgh, Pa., contract FA-1921(1-3155B1), heater, space, 240 volt, single phase, 60 cycle, portable, 2 kw., 30 ea. and 4 kw., 350 ea., $29,467.



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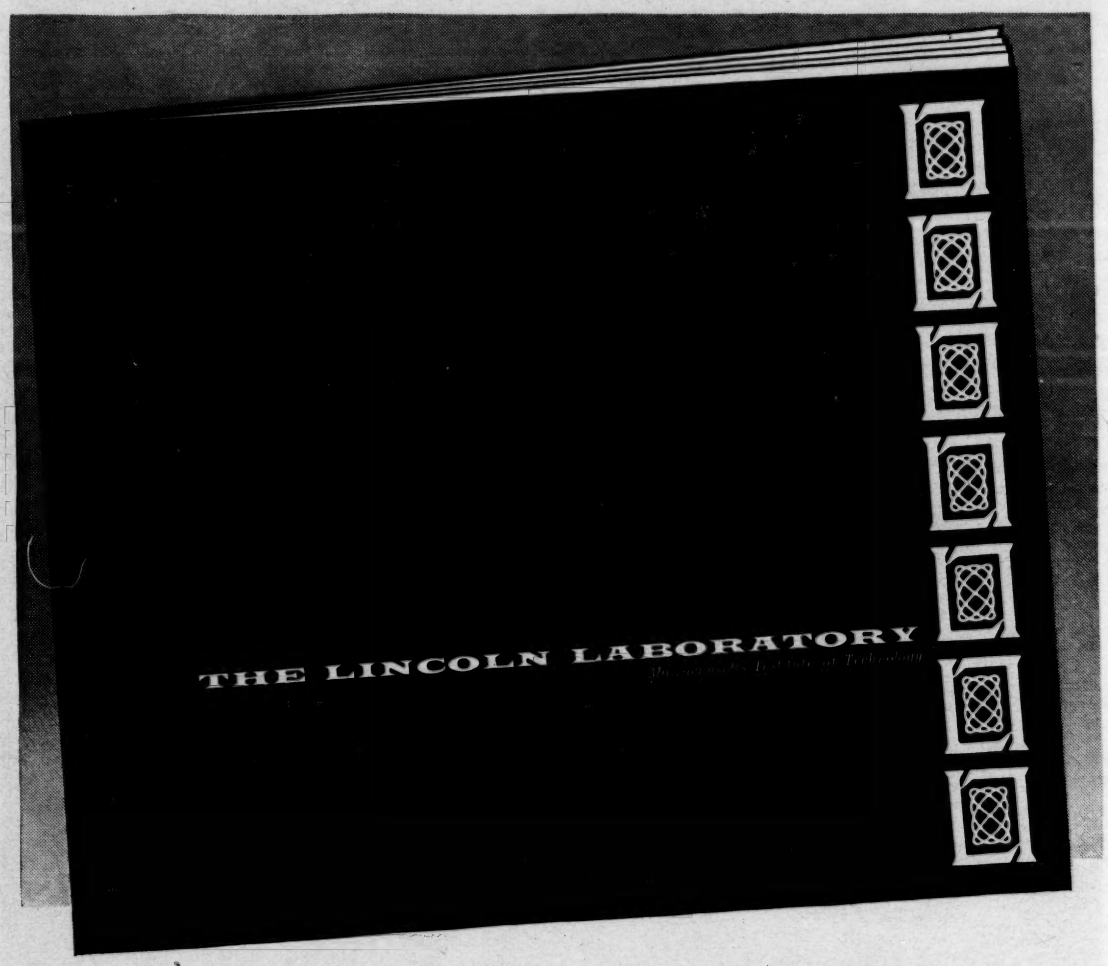

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WHO'S WHERE

(*Continued from page 23*)

Changes

Dr. Lewis R. Koller, research associate, and **Dr. Dilip K. Das,** project manager, National Research Corp., Cambridge, Mass.

James E. Starr, research director, Allegany Instrument Co., a division of Textron Electronics, Inc., Cumberland, Md.

Raymond V. Bruland, manager-aviation product line, Cedar Rapids (Iowa) Division of Collins Radio Co.

Andrew J. Peterson, manager-military relations, and **George M. Quinn,** staff manager-marketing, Goodyear Aircraft Corp., Akron, Ohio. **John M. Feldscher** succeeds Mr. Quinn as manager of Aero-Mechanical Division Sales. Also: **Robert L. Lowry,** departmental head-Avionics Sales; **Richard H. Haas,** departmental head-Plastics Sales.

Fred Egitto, liaison manager-radar and communications, Electronics and Ordnance Division, Avco Corp., with offices in Rome, N. Y.

Louis R. Farin, programs and contracts manager, Bulova Research & Development Laboratories, Inc., Woodside, N. Y.

T. V. Chandler, director-new product development and long-range planning, Canadair Ltd., Montreal, Canada, a subsidiary of General Dynamics Corp. **W. H. Meacher** succeeds Mr. Chandler as director of manufacturing administration.

Dr. Edgar L. Armi, chief of applied manufacturing research, Convair (San Diego, Calif.) Division of General Dynamics Corp.

Lockheed Missiles and Space Division, Sunnyvale, Calif., has realigned its satellite programs and appointed the following deputy directors: **James W. Plummer,** head of special satellite programs; **Walter V. Ryminski,** head of military satellite programs.

L. A. Bassett, manager-transistor sales, General Electric Co.'s Semiconductor Products Department, Liverpool, N. Y.

Donald H. Hayes, quality assurance manager-Nike ground support wheeled vehicles, Fruehauf Trailer Co.'s Military Equipment Division, Detroit, Mich.

Richard A. Flume, chief engineer, Braniff Airways, Inc., and **V. F. Fairchild,** manager of ground operations–domestic and international systems.

William A. Rabe, manager, Surface Radar and Electronic Warfare Development Laboratory, Military Products Division, General Dynamics/Electronics, Rochester, N. Y.

Dr. Shigeo Okubo, manager-gyro platforms, Precision Products Department, Nortronics, a division of Northrop Corp., Norwood, Mass.

Allen C. Miller, II, director of military marketing, Los Angeles (Calif.) systems division of Acoustica Associates, Inc.

A. M. Breit, director of customer relations, Cook Electric Co.'s Air Mod Division, Franklin Park, Ill.

James N. Mellor, manager of manned vehicles and supporting systems, Republic Aviation Corp., Farmingdale, N. Y. **William P. Morris** succeeds Mr. Mellor as Republic's assistant Washington (D. C.) representative.

Ronald Clark, European sales manager for the Flying Tiger Line, with headquarters in London, England.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA

LETTERS

Balloon Flight

I note on p. 87 of your edition of Jan. 23 that ARDC and Capt. Joseph W. Kittinger are planning a "First manned balloon flight carrying a telescope . . ."

To set the record straight, I believe you have overlooked previous flights in Europe and this country with telescopes carried aloft. The most significant of these was the history-making STRATO-LAB 4 flight of Nov. 1959 in which Cmdr. Malcolm D. Ross, USNR, of the Office of Naval Research, and Mr. C. B. Moore, of Arthur D. Little, Inc., flew a 2,000,000-cu. ft. balloon to 81,000 ft. to make important scientific observations of the planet Venus through an externally mounted 16-in. Schmidt-type telescope. The flight was launched from the Stratobowl, Rapid City, S. D., late in the morning of Nov. 28 and landed about 28 hr. later near Manhattan, Kan. The flight was acclaimed generally as being a great success, and it brought back the first evidence that the atmosphere of Venus contains water vapor.

AVIATION WEEK, on p. 27 of its edition of Dec. 7, 1959, speculated in its report of the flight that this evidence of water vapor might indicate a possibility of life on Venus. The principal scientist for this effort, Prof. John Strong, of the Johns Hopkins University, however, has refused to speculate.

W. D. DEIBLER
Commander, USN
Technical Information Officer
Department of the Navy
Office of Naval Research
Washington, D. C.

(AVIATION WEEK *was right the first time, Cmdr. Deibler is right on both counts.*—Ed.)

Revamped Meetings

At our last meeting of the steering committee for the 1961 National Symposium on Space Electronics, the article appearing in the Nov. 21 issue of AVIATION WEEK ("Increasing Conventions Come Under Fire," p. 73) was discussed. It was the consensus of opinion that you presented the case very well. It was also apparent that those of us who become involved in presenting such meetings are at least as aware of the problem of too many meetings of too little value as anyone else.

We did not accept the alternative of abandoning the 1961 symposium. We didn't feel we had the right to do so if the Professional Group on Space Electronics and Telemetry is to have a meeting it can refer to as its own annual technical conference. Instead, we have taken the liberty of introducing rather modest ideas in our plans for a technical program.

First, there will be six sessions in the three days (Sept. 5, 6 and 7, 1961), none in parallel. The sessions will be confined as much as possible to space electronics, with only incidental attention to the "telemetry" in the organization name. This latter move is in recognition of our organization's support of the National Telemetry Conference

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

1961 to be held in May this year. In that conference, we are but one of five sponsoring organizations and we are trying to leave the telemetering field to it. Our sessions will be devoted as to much as possible to invited papers which discuss the electronic techniques which are being used or planned to solve instrumentation and communication problems in investigation of space. Our emphasis will be on quality rather than quantity, and by grouping techniques in ground-based experiments together in one day, space-based experiments on another, and those which cannot be divided on a third day, we hope to make it possible for those who can spend a limited time to catch the sessions of their interest without going into too many different days. We are even considering double presentations of papers (first day papers repeated on the third day in a parallel session perhaps) to accommodate the person with divided interest and minimum time. Also, by holding the meeting in Albuquerque, we feel we can stand to duplicate to some extent material that has been presented on the East Coast, since it will be new to most of those who will attend in this area.

Some of these innovations (or are they reversals of form?), we hope, will make attendance at our annual symposium more worthwhile for those who do attend this year.

B. L. BASORE, Chairman,
Technical Program Committee
1961 National Symposium on
Space Electronics

Standardization Need

Reader W. L. Snodgrass (AW Jan. 16, p. 136) is correct when he states that all flight instrument panels should be standardized.

The problem of non-standardization is well illustrated on p. 109 of the same issue of AW which shows a picture of the instrument panel of the new Mooney Mark 21. Not only does the location of these instruments bear no relationship to those of any other light aircraft, but their positions on this particular panel are open to question. Specifically: why has the cockpit designer insisted that the most important place on the instrument panel—directly in front of the control wheel, in line with the eyes—be occupied by the clock? We are all familiar with the hangar pilot who brags he can fly instruments on the outside air temperature and the clock, but surely the average pilot will find the positioning of the directional indicator in place of the clock more advantageous to sound instrument flying.

My experience with light aircraft demonstrates that a similar confused instrumentation philosophy is accepted by the other manufacturers. The result is that I invariably step out of the cockpit of a light aircraft convinced that the instrumentation was an afterthought in design, evidenced by the way the instruments seem to have been indiscriminately scattered over the panel.

The need for a sound standardized instrument panel is all the more imperative now that the new FAA regulations insist on some rudimentary flying ability from any fledgling pilot. In this respect, if the manufacturers will not agree on a standard panel, then the FAA should assume the obligation to enforce them to adopt one. The resistance will undoubtedly be on economic grounds; but the economic losses alone, incurred through crashes where cockpit disorientation was a factor, justify the need.

The type of standardization is immaterial, although there is much credit to the standard "T" grouping already adopted by the major airlines of the world. This consists of the artificial horizon in the center of the panel, flanked to the left by the airspeed indicator, to the right by the altimeter, and below by the directional indicator. Location of any other instruments can be left to the discretion of the manufacturer as this minimum "T" is all that is really required. No more should be required because this would tend to act as a deterrent to further research in this important field.

GEORGE FULFORD
Seattle, Wash.

Losing Battle

Kudos for Waldo M. Claflin (AW Jan. 16, p. 136) and his losing battle with the pseudo-sophisticates. That makes two of us.

My pet peeve, however, is the engineer who plans to "instrumentate" (or instrumentize) a parameter. The fact that I know he means to "instrument" (verb) is not consoling.

I recently attended a seminar wherein a technically knowledgeable individual said "applicated" when he meant "applied"! It was distressing to note that the audience was apparently "snowed" by the lecture.

I've completely given up the semantic battle against those who insist on double-pluralizing "equipment," already plural, to "equipments."

JOHN A. MAIN
Woodland Hills, Calif.

Languagewise, considerable bravofication is one's natural-type reaction to W. M. Claflin's crucification ("Letters," AW Jan. 16, p. 136) of "overflight" and other verbal excesses. On the other hand, there are probably even more problems created by writers like P. H. Lindgren (same page, same issue) who use ostensibly simple language ("traitor," "fact") in such a way as to annihilate meaning.

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